

ABSTRACT

OF THE

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REPORT OF THE LEPROSY COMMISSION IN INDIA,

(Specially Prepared for the INDIAN MEDICO-CHIRURGICAL REVIEW)

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Report of the Leprosy Commission in India.

AN ABSTRACT.

(Specially prepared for THE INDIAN-MEDICO CHIRURGICAL REVIEW.)

We propose in the following pages to give a comprehensive abstract of the report of the Indian Leprosy Commission, which was issued simultaneously in England and in India on the 1st instant.

The report is dedicated to the memory of the late Surgeon-Major Arthur Barclay, one of the Indian Members of the Commission, who died at Simla on the 2nd of August 1891.

Introduction.

Our readers are aware that the revival of interest in leprosy was due to the untimely and sad death of Father Damien de Veuster, who died of leprosy at Molakai in 1889, and who had devoted the last sixteen years of his life to the relief of the sufferings of the Hawaiian lepers. About two months after his death, a public fund under the name of the "National Leprosy Fund" was started, in England, at the initiative and under the patronage of H. R. H. the Prince of Wales and a representative committee including several eminent members of the Medical profession. The Executive Committee of the Fund decided upon the appointment of an Indian Leprosy Commission in conjunction with the Government of India. The three English Commissioners, Drs. Beaven Rake, George A. Buckmaster and A. A. Kanthack were appointed by the Executive Committee of the National Leprosy Fund and the Royal Colleges of Physicians and Surgeons; Surgeons-Major Arthur Barclay and Samuel J. Thomson were nominated by the Government of India to work with the English Commissioners.

The English Commissioners arrived in Bombay on the 17th of November 1890, where they were met by the Indian representatives. It was then arranged to commence the enquiries locally and then to visit the various centres throughout India where leprosy prevailed or lepers congregated in large numbers.

Forms of Leprosy.

In the course of their enquiries, they examined about 2,371 lepers at the following places ; of these, 1,310 were cases of anæsthetic, 284 of tubercular and 719 of mixed leprosy :—

Asylum or Locality.	Anæsthetic.	Tubercular.	Mixed.	Disease not stated.	Total.
Agra	38	1	15	.....	54
Aligarh	8	1	1	.....	10
Alnora	74	2	32	.....	108
Bangalore	49	2	4	.....	55
Belgaum.....	1	2	... ..	20	23
Benares	27	1	4	.....	32
Bombay	135	87	35	2	259
Burdwan	8	1	12	.....	21
Calcutta.....	52	6	30	1	89
Calicut	12	1	13	.....	26
Cawnpore	8	.....	2	.....	10
Conjeeveram	8	2	6	2	18
Darjeeling	2	.....	1	.....	3
Dehra Dun.....	46	4	38	.....	88
Delhi	4	1	6	.....	11
Dharmasala.....	7	.....	5	.....	12
Fyzabad	13	1	3	.....	17
Gwalior	7	.. ..	6	.....	13
Gya	28	4	10	....	42
Hyderabad	7	3	11	.....	21
Jabalpore	9	.....	6	.....	15
Jummoo.....	1	.....	.....	1	2
Kapurthalla	8	2	.....	.....	10

Asylum or Locality.	Anæsthetic.	Tubercular.	Mixed.	Disease not stated.	Total.
Lahore .....	.....	.....	2	.....	2
Lucknow	10	.....	3	.....	13
Madras	106	19	57	2	184
Madura	64	9	36	4	113
Mandalay	51	21	102	3	177
Meerut .....	.....	.....	.....	9	9
Moulmein	12	4	9	.....	25
Nagpur	94	27	52	1	14
Naini and Allahabad	48	2	16	.....	66
Naini Tal	1	1	.....	.....	2
Patiala	7	1	1	.....	9
Peshawar	1	1	.....	.....	2
Poona.....	14	31	.....	.....	45
Prome.....	4	14	12	.....	30
Purulia	57	3	34	5	99
Rangoon... ..	21	1	40	.....	62
Rawalpindi ...	37	.....	10	.....	47
Sialkot	27	6	6	1	40
Subathu	34	4	8	.....	46
Tanjore	9	2	5	.....	16
Tarn Taran	103	2	36	5	146
Thayetmyo	23	11	28	.....	62
Trichinopoly	9	2	3	2	16
Umballa.....	21	1	10	.....	32
Yerrowda Prison...	5	1	9	.....	15
Total....	1,310	284	719	58	2,371
Percentage...	56.6	12.2	31.0	.....	.....

Age.

As regards the age at which persons become lepers, the most common limit was between the ages of 26 and 30; the next most frequent period was from 21 to 25 years and then from 16 to 20. This shows that leprosy is a disease of early adult life. The Commissioners, however, found that about a little over 9 per cent. acquired the disease before the age of 10.

Sex.

At an early age, that is up to 5 years, the sexes of the persons affected were nearly equal, there being 28 males to 21 females. From 5 to 10, however, the proportion of males attacked increased, and there are shown to be 95 males to 56 females. But the Commissioners were not able to positively affirm the ratio between the two sexes above the age of ten, as very few adult women were seen by them.

Expectation of Life.

The want of actual experience in India debarred the Commission from expressing any opinion on this subject; but, from statistics gathered from other places, it may safely be said that the average duration of tuberculated leprosy is between eight and a half to nine and a half years, whilst that of anæsthetic leprosy is between twelve to fifteen years.

Errors in Diagnosis.

Of 2,487 persons produced for examination as lepers, 125, that is five per cent., were found to be suffering from various diseases, mostly syphilis, leukoderma and skin affections, e.g., psoriasis, ringworm, acne, eczema, &c.

Ainhum.

The condition known as ainhum, which occurs associated with leprosy, was marked more or less in several cases

examined in India. It affects lepers or healthy persons, and when the latter, nearly always attacks the little toe of one or other foot ; whereas in lepers any toe, or even fingers, may be attacked. A Hindoo boy, aged ten, was examined at the Matoonga Leper Asylum ; the little toe of the left foot was found to be enlarged, the outline convex and the skin thickened and completely anæsthetic. There was a furrow all round the base of the toe, extending nearly half through the toe, except on the dorsum. The toe could be freely moved about, the bone having been absorbed. The skin beyond the furrow was thickened and somewhat painful.

The occurrence of ainhum in any individual should, however, always suggest a most careful examination for anæsthesia and other leprosy symptoms.

Geographical Distribution of Leprosy.

The Imperial Census Reports are the bases on which the geographical distribution of leprosy in India has been based. The lepers were enumerated in the three Censuses of 1872, 1881 and 1891. Although the number of lepers so enumerated could not be absolutely correct, for faulty diagnosis by unprofessional enumerators and the exclusion of females according to the purda system, must render the returns imperfect and faulty. Such as they are, they form the only data, and they cannot be considered altogether worthless, for they possess a high relative value which would be greatly enhanced in future as census follows census. The Commissioners have therefore felt the insecurity of the ground invaded, and think that the arguments that can be cautiously deduced from the three sets of figures must be taken rather as suggestions for future verifications than their actual correctness.

Leprosy has been called an "Imperial Danger," and Imperial no doubt leprosy is, for no part of India is free from it. But a danger it can only be, if it be shown to increase at such a rate as to undermine the health and life of the general population. Those who speak of the great spread of the

disease can evidently have no other support for their arguments than that afforded by the census returns, and they must stand or fall by them; for them the value of these figures are absolute, and hence the Commission has fully considered this subject as of the greatest importance to the Empire. In formulating their opinions on this subject, the Commissioners express their diffidence on account of their investigations having been carried out in a country of which they knew but little, and they were fully aware of the uselessness of instituting comparisons between Indian and European life and applying the Western standard to all conditions in the study of a disease like leprosy.

Leprosy is found in all parts of British India and in almost all Native States, but the prevalence of the disease varies in different presidencies and provinces. Thus, in the Census of 1872, Madras, though not containing the fewest lepers, taking the absolute numbers, presents the lowest ratio, *viz.*, 44 to 100,000, Bombay 85, and Bengal stands intermediate. According to the Census of 1881, Madras is again the lowest with 47, Bombay has 61 and Bengal just exceeds this. As in 1871, certain districts in Bengal, as Bankoora, Beerbhoom, Simla district, Dehra Dun and Kumaun contain 161 to 372 lepers per 100,000 of the population. The Census of 1891 shows a general decrease of leprosy all over India, and the highest ratio is again found in the districts above-named, where it stands at about 350.

The following table shows the changes in the number and the proportion of lepers in the three presidencies according to the three census returns, including some Feudatory States, but excluding the Central Provinces, portions of the Central India Agency, Hyderabad and Rajpootana, the returns for which were not available at the time when this report was being prepared :—

Presidency.	Total Population, 1st Census.	Total Number of Lepers.	Proportion per 10,000.	Total Population, 2nd Census.	Total Number of Lepers.	Proportion per 10,000.	Total Population, 3rd Census.	Total Number of Lepers.	Proportion per 10,000.	Remarks.
Bengal.....	135,294,838	11,287	5.2	154,106,069	98,017	6.3	155,818,269	80,426	5.1	
Madras	31,152,272	13,944	4.4	31,170,631	14,525	4.6	38,471,281	13,771	3.7	
Bombay	23,363,187	18,794	7.8	23,301,370	12,382	5.3	26,960,421	12,741	4.7	
Lower Burma	2,747,148	3,203	11.6	3,736,771	2,589	6.9	4,658,627	2,960	6.3	
Upper Burma .....	.....	.....	...	.....	.....	...	2,946,550	3,504	11.8	
Mysore & Coorg.....	5,223,724	1,579	3.0	4,364,490	576	1.3	5,116,659	837	1.6	
Grand Total for India ...	198,286,169	108,807	5.4	216,679,331	128,089	5.9	233,971,807	114,229	4.8	

It will be found that, generally speaking, the ratios for the present census are lowest, thus indicating a relative, if not an absolute, decrease of leprosy, as far as it is possible to argue from such figures.

It has been maintained by some that leprosy is most prevalent on the *sea-coast and on borders of large rivers*. Mr. Hutchinson asserts that it chiefly prevails on the sea-board or in valleys, but the Commissioners find that the disease is most prevalent, as a rule, inland. In fact, for the 1st and 2nd censuses, the lowest ratio of lepers was found all along the Gangetic valley and in the four "doabs" and along the coast from Kurrachee to Ahmedabad. So it is, generally speaking, with other rivers. *Now since also along the sea-board and larger rivers the prevalence of leprosy on an average is much below that of the inland areas, it cannot be said that the earlier enumerations established any proof in favour of the statement that in India the disease has a preference for the former tracts.* These were, however, the only figures at the disposal of writers, previous to the recent census, which points strongly against the prevalence of leprosy along the shores of the sea or the banks of the large rivers.

Some *hill tracts* are specially attacked by leprosy, which fact is due to certain inherent conditions apart from the influence of immigration. According to the last census the following hill districts of India had the proportion of lepers per 10,000 as mentioned against them :—

Chamba—34·0 : Simla, etc.—28·8 : Nahan—21·2 : Dehra Dun—20·5 : Kumaun—19·7 : Garhwal (British)—16·9 : Mandi—14·9 : Bashahr—13·3 : Garhwal (Native)—12·8 : Kangra—10·8 : Darjeeling—7·5 : Suket—4·1.

Hence, with regard to the geographical distribution of leprosy in India, it cannot be said that the sea-coast, riparian areas or large valleys are affected more than the other districts in the country. The disease attacks all tracts impartially, and so far as the surface relations are concerned, no generalizations whatever can be made. Similarly, no

connexion can be traced between the geological formations and the density or distribution of the leper population.

Increase of Leprosy.

After making all due allowances for errors, omissions, and changes in areas included in the three sets of census figures available, the Commissioners state that it is plain that the recent outcry about an alarming increase of leprosy in British India is not based on fact, and that such increase has not taken place. On the other hand, the figures suggest a decrease rather than an increase, especially if it be remembered that immigrations of lepers into British territory takes place to a great extent.

The 1st census (1867—72) gives a population of 182,000,000, with the numbers of lepers at 100,000 and the ratio at 5·0 per 10,000.

The 2nd census (1881) states the population at 191,000,000 and the number of lepers at 115,000, with the ratio of 6·0. In the 3rd census (1891) the total population is 210,000,000, the numbers of lepers 105,000 and the ratio 5·0. Between the first and the second census there is found to be an increase of lepers by 15,000, and the Commissioners believe that even if this increase was real and not due to any mistakes in counting, it means that of the populations, after an interval varying from nine to fourteen years, less than '0001 became diseased. Such an increase, if it actually existed, can hardly be considered in the light of a danger. But the last census shows an actual decrease which cannot be in harmony with the cry about an alarming increase and the "Imperial Danger." Taking all in all, and giving due consideration to the apparent increase as shown by the 2nd census, the Commissioners think that if leprosy could not be said by some to have materially decreased, still there are no data forthcoming to show that it has increased, and hence, for all practical purposes, it may be considered to have remained stationary. *Loath to give a decided opinion on this subject, the*

Commission think that the evidence of the censuses excludes the idea of an increase of leprosy, and points rather to a gradual decrease at the present time; but it may be safer to assume that the diffusion of this disease has remained stationary. Anyhow, an "Imperial Danger" leprosy has not become as yet. In concluding this section, the Commissioners state that they do by no means regard the figures on which they have based their conclusions as absolutely correct, but, nevertheless, as the best obtainable and of some value. To reject them altogether and to substitute the numbers derived from general impressions of medical officers whose attention has been suddenly attracted to the disease, and from the study of Dispensary returns, is unreasonable. They claim, with a fair amount of justness, that whatever errors the census returns contained, they do not under-estimate the true state of affairs by much, if at all. Under these circumstances, the later estimates of the actual leper population at the present time as being 250,000 to 500,000 are based on impressions only, and are more guesses of extremely questionable, if any, value.

Climate and Leprosy.

Climate cannot be considered the cause of the disease, for leprosy exists in all latitudes. In estimating the relation between climate and leprosy in so vast a country, it is impossible to exclude all such factors as food, race, soil, and habits of the people. The smallest proportion of lepers are found in the driest areas, and although it is not maintained that the dryness of the climate is the sole, or even a chief, factor in the numerical distribution of the disease, yet it must always remain a significant and suggestive fact that the leper ratios vary inversely with the dryness of the climate. The census of 1891 gives the following scale of ratios per 10,000 for the various areas arranged according to dryness of climate : —

Bellary, etc.—1 to 2 ; Sind—·7 ; South-West Punjab—1·0 ; Rajpootana—1·4 ; North-Western Provinces and Oudh—3·6 ;

Behar—4·5; Chota Nagpore—4·4; Bengal—6·2; Cachar—11·6; Assam (inclusive of Cachar)—12·2.

This shows that with increasing dampness the ratio of lepers tends to increase.

The dryness of a climate depends chiefly on the temperature, humidity and rainfall, and the Commissioners have arrived at the conclusion that the facts known to them do not warrant a statement that there is any relation between leprosy and heat. On comparing, however, the rainfall humidity, it seems that there is an apparent connexion between the dryness of the climate and a small leper population. Whether this is only accidental, it is difficult to say, and perhaps too much importance must not be attached to it. It is not intended to advance any theory on the strength of these observations, yet the fact seemed significant enough to the Commission to merit special mention, all the more, as all three censuses bring out this general principle.

Leprosy and the Increase and Decrease of Population.

All the census reports bring out the fact strongly that no connexion exists between the increase and decrease of the populations and the leper ratios. The last census, indeed, shows that, though general population has increased, the number of lepers has materially diminished during the last decade. Three tables are given in the report, which show that no relativity can be established between the amount of leprosy in a particular district and the rate of increase on the one hand, or the comparative rate of mortality of the same on the other. The death-rate is dependent to a great extent on climate, epidemic fevers, endemic disease, and similar conditions, and it might *à priori* be expected that the diffusion of leprosy could not depend on such causes *per se*, though the conditions leading to the constant presence of a specific disease in any particular area may possibly cause a special predisposition towards leprosy. The factors to be considered are the personal health and wealth of the individual and the

degree to which he is liable to suffer from such diseases as are caused by bad nourishment, poverty, over-crowding and other specifically endemic conditions. To obtain such details is exceedingly difficult in a vast Empire like India.

Leprosy and Cholera

The Commissioners, whilst not suspecting a direct connexion between leprosy and cholera or implying that the causes which lead to cholera bring about a totally different morbid condition, have adopted cholera as a test of the climatic and local healthiness and sanitary state of areas over which leprosy prevail.

In the course of their investigations, they found that the Burdwan Division, Lower and Eastern Bengal and Burma, which show almost highest relative number of lepers, had one striking feature in common, *viz.*, the perennial existence of cholera and fever. In such areas where these diseases rage at all times and seasons cannot be considered healthy, and must present certain permanent specific conditions whatever view may be held regarding their ætiology. Regions where cholera is endemic must be in the possession of certain definite, though at present perhaps unknown factors; and if it be found that in these regions leprosy is also common, may it not be possible that the deleterious conditions, which cause the fever to be endemic, exercise a specific influence on the general health of the population? In the present day, sufficient evidence exists to make it appear quite possible that bad health and hygiene, poverty and over-crowding play at least some, if not an important, part in predisposing towards and developing such diseases as leprosy and tuberculosis, and hence the Commissioners do not think it irrelevant to inquire into the correlation between leprosy and endemic cholera. Dr. H. W. Bellew considers that in the following districts and provinces cholera is endemic, and it is found from the figures of the three censuses that the highest leper ratios exist in the most choleraic districts in India:—

Bengal Proper—6·9 per 10,000 : Behar—4·5 : Orissa—11·0 :
Assam—12·3 : Burma—6·3 : Konkan—8·3.

The Commissioners conclude that in those areas and regions in which cholera is worst and endemic, the leper diffusion is also greatest. The perennial existence of cholera and fevers in the districts above named lower the health and vitality of the population, thus lead to a diminished resistance against infective process and predisposing towards these diseases.

If this be so, and Burma, Lower Bengal, Assam and Orissa, on the strength of this, considered hygienically, the most unsound districts, this fact may be accepted amongst others to explain the great amount of leprosy in such districts as Burdwan, Assam and Burma.

Leprosy and Famines.

Nine districts in the Madras Presidency suffered from famine, which prevailed from 1876 to 1878, whilst thirteen districts were spared altogether. A relative increase of leprosy can be established in eight of the thirteen, whereas it is only possible in two out of the nine famine districts. In the Bombay Presidency, among the eight districts affected, no increase could be traced in a single case. It is therefore possible that lepers, under such unfavourable conditions, died in large numbers; but it is impossible to estimate the actual influence of famines, as no exact data are forthcoming regarding the number of lepers that died during those years. There was a severe famine in Bengal in 1866, and the distress in some parts was so great that the poorer classes were reduced to living on the seeds and berries of wild trees, grass and herbs, and it is highly probable that, under such conditions, the leper had but little chance of survival. It was found that in the first census after the famine, the leper ratios were comparatively low, except in Gya, lower than in 1881, while in the latter year in many regions there was a remarkable increase. This is explained by the fact that the severe distress of 1866 and the previous years decimated the lepers, while the unfavourable conditions during the next ten years affected the population in such a manner as to make it more liable to contract leprosy. The ratios which have been

worked out have a relative value of fairly sufficient accuracy attached to them as the enumerations occurring only once in every ten years, it is impossible to check the figures in anything like a satisfactory manner, and they moreover tend to show that a famine shortly before a census apparently has a tendency to reduce the leper ratio for such province. In the Central Provinces there was severe distress during 1868 and 1869, and it is found that in 1872 the leper ratio amounted to only 2·7 as against 6·5 in 1881. In the Bombay Presidency an intense famine reached two years before the second census, and the leper ratio in 1881 was 2·4 per 10,000 less than in 1872. A table is appended in the report which bears out the above statement that a famine before a census may possibly affect the relative diffusion of leprosy over a given area, and this point must not be left out of sight in the study of the ætiology of the disease by a comparison of the density of the leper population in various presidencies or provinces. During seasons of distress such as it is perhaps only known in India, life is reduced to a struggle for existence, and herein the leper must succumb quickly, partly on account of his own miserable condition, partly on account of the poverty of his fellowmen, which compels them to withhold the helping hand. The Commissioners, therefore, realize the difficulties in their way in considering this subject, and they state that on this account they have had to merely allude to matters of great importance and to keep all arguments on the broadest lines, and in many cases to merely suggest hints for future guidance than to lay down deductions.

Since these famines great improvements in the material prosperity of the people have occurred, and the changes in the well-being of the people have become more visible during the last decade, and if the results of the census of 1891 are applied to this inquiry, it is found that there is an almost general decrease of leprosy all over the country. This, after making due allowance for errors, can only be explained by the fact that it is due to the improvement of the condition of the people.

Poverty and Leprosy.

Leprosy attacks the poor and destitute much more frequently than the rich and prosperous ; the latter, though not spared altogether, suffer to a far less degree. The question then arises, do the leper ratios vary with the material prosperity of the masses ? India cannot be called a rich and prosperous country, nearly 72 per cent. of the whole male population are engaged in agriculture, and the Famine Commissioners estimate that 90 per cent. of the rural population live more or less by the tillage of the soil. There is no connexion between the natural richness and fertility of a province and the leper population.

Leprosy is undoubtedly a disease which affects the masses more than the wealthy. And although it may not be possible to prove this statement beyond all doubt, but nevertheless, for India at least, the fact exists. Are those districts where the disease is commonest also the poorest ? The material prosperity of an area depends upon its agricultural produce and the number of people it holds. Notwithstanding the richness of the areas, the fertility of the soil, and the abundance of crops, if the population is over-crowded as in the Burdwan Division, the land cannot supply food for all, and besides this, the perennial prevalence of cholera and malarial fevers makes this division the most unhealthy, and all these factors combined lead to a greater prevalence of leprosy, although absolutely the division might be considered rich, and hence likely to contain less lepers.

Assam is a poor district, the climatic and telluric conditions are unhealthy and the population live in poverty. But it is found that in the most prosperous districts of this province the leper population is comparatively scanty. And so, too, in Burma, where the census figures for 1871 and 1881 are high, whereas there is now a marked decrease in the leper ratio owing to great improvement all over the country. Leprosy is not very prevalent in the Punjab and North-Western Provinces, as these are considered, as a whole, prosperous tracts. In the Bombay Presidency the poorest districts—

Ratnagiri, Kaladgi, Ahmednagar, Sholapur, Satara, and Thana—show an average of higher leper ratio than the prosperous districts—Kaira, Broach, Dharwar, Kanara, Khandesh, Ahmedabad and Belgaum. In concluding this section, the Commissioners again refer to the many difficulties encountered by them, to the vastness of India and to an imperfect knowledge of the habits, customs and material condition of the people, and they again refer to the census figures as being of only relative value. They further state that all the statements made by them on climate, cholera and famine are not to be taken as absolute, free from doubt or above criticism, nor do they convey the idea that a severe famine invariably acts on the leper population in a particular manner, but that it may do so, and that if the census figures be correct, it, in many cases, seems to do so. Again they do not consider a particular climate the cause of a scanty leper population, but they do claim that a climate combined with the telluric, geological, ethnological and other conditions of a district may have a definite influence. Again, they have taken cholera as a test of unhealthiness and bad hygiene, and they suggest that in a district where cholera is perennial, the surroundings may be such as to favour the diffusion of leprosy. They believe that the greater the poverty of the district the more prone the latter is towards leprosy, and they express the strong belief that the numerical diffusion of leprosy depends, among other factors, greatly on the well-being of the population, and that with the furtherance of prosperity, education and hygiene, and in fact with a substitution of a standard of maintenance for that of subsistence, leprosy will materially decrease in India as it has done in Europe.

Leprosy and Endemic Diseases.

Just as in tuberculosis there are certain factors predisposing to the affection, so also the general susceptibility of leprosy of a district and its inhabitants depends on certain factors connected with the climatic, economic, social or hygienic conditions which establish the endemic nature of

this effect. Leprosy is an infectious disease, but besides the *contagium vivum*, a certain predisposition is necessary to produce the disease, and therefore it can only be endemic in areas where, besides the virus, those factors also exist which are held responsible for the special predisposition in the individual. The bacillus lepræ in the resting stage is the virus, but as yet the living microbe has not been found outside the human body. Assuming that since the disease is highly prevalent, this virus is widely distributed throughout space, and that special conditions of an area largely predispose its population, it is evident that every facility is offered for an acquisition of the disease *de novo*, that is an acquisition of leprosy apart from contagion. Indeed, if the virus is widely distributed, contagion may be practically neglected, since all measures directed against the latter could be of no avail in stamping out the disease. It is not intended to imply by the term *de novo* that the parasite is of no ætiological importance, but that the microbe may reach the body and set up the disease quite apart from contagion if only the required disposition exists. At the present time it is an only too common practice to consider any disease dependent on a specific organism, contagious under all conditions alike and without allowing degrees of contagiousness. The conditions under which a disease becomes contagious are often regarded as unimportant, and it is these which actually lead to the establishment of a predisposition. Contagiousness is an extremely relative term and general causes such as poverty, famine and precarious living may lead to a special disposition towards a disease—may, in fact, cause such disease to be endemic over a certain area. The virus may remain unchanged all the time, but an alteration in the organism of the individual owing to the causes above-named may establish a predisposition or even cause the disease. An endemic area then should fulfil two conditions :—(a) the virus must be present in some form or other, (b) and such conditions must exist as are calculated to exercise a special predisposing influence on the population, thus enabling the parasite not only to enter the body but also to grow and thrive in the same. All the districts where leprosy is

exceedingly prevalent agree chiefly in the following points, *viz.*, the existence of poverty, insanitary conditions, over-population, unhealthy or moist climate. It is highly probable, it is quite legitimate, to assume that as the disease has existed in India since antiquity, that the virus also abounds in such districts, and that the bacilli are in a resting stage ready to encounter the susceptible individual. This assumption of a dormant condition of the bacillus lepræ outside the human body is a mere hypothesis; but, such as it is, it explains all the facts in the diffusion of leprosy, and is, in reality, also accepted by those who believe in the spread of the disease by means of contagion, when they attribute the acquisition of leprosy to such acts as the washing and wearing of leprosy clothes, and so forth. Again, there are similar cases in bacteriology, *e.g.*, tetanus, where the specific organisms no doubt exist, in the soil or dust, in the form of spores, and yet have never been demonstrated microscopically.

Leprosy is not more frequent in some parts as Bankoora and Assam, because the people are more careless here in their intercourse with lepers, but because the conditions here are more favourable to the origin and spread of the disease, just as the greater prevalence of tuberculosis among the industrial classes, as compared with the agricultural population in England, is not accounted for by the assumption that the former expose themselves more recklessly to the risks of contagion. The fact that in these districts where leprosy is extremely prevalent but little changes in the affected population have taken place during the last 30 years, points rather to the existence of general conditions leading to a specific disposition. For there is no evidence to justify the assumption that the native is more careful in his intercourse with lepers now than he was a generation ago. Yet the disease remains stationary; indeed, probably is slightly on the decrease. The question arises, "What is this due to?" This is explained by comparing what has happened in England in the case of tuberculosis. Since 1858 there has been a steady decrease in the mortality from phthisis both in the

agricultural and industrial population, and this decrease has been more rapid than that of mortality from all causes during the same period. Again the decrease has been proportionately greater in the industrial than in the agricultural classes. From these facts it follows that the decrease in the general mortality establishes that a gradual improvement in the vital condition in England has taken place. This steady decrease in the phthisis mortality is mainly due to sound hygienic principles and to sound hygienic measures.

Applying these facts to leprosy, if the decrease in the leper population, according to census statistics, is an actual one, does it not seem more reasonable to assume that this is due to the improvement in the social and hygienic conditions which undoubtedly has taken place during the last quarter of a century? If such decrease, however, be not accepted, may it not be expected that by means of such improvement the leper population, instead of remaining stationary, will gradually diminish? As it is impossible to attack the virus itself, the remedy lies in counteracting the agents which are responsible for predisposing individuals to leprosy, and it is hoped with a fair amount of success. There is, in India, a tendency towards a decrease of the disease, and this is assuredly due to the rapid progress of the social, economic and hygienic conditions all over the Empire. With a further and continued improvement of these, it may be hoped that in India leprosy will cease to be an endemic disease.

Density of Population in Relation to the Diffusion of Leprosy.

No law exists as regards the relation between the leper diffusion and the density of population. A table is attached in the report comprising Bengal, Bombay, Madras and the Punjab in proof of this assertion.

Predisposition of Races.

The population of India is varied in the extreme, and it consists of the dark aboriginal races, descended from the

original occupants of the country ; of the lighter-tinted descendants of the Aryan and Scythian immigrants ; of the mixtures of the two above ; of immigrants from the coasts, such as Parsis, Jews, Arabs, and the English and other Europeans ; and lastly of Eurasians, the mixed descendants of Europeans and other races. The population of Burma is more uniform. Now, leprosy affects all these ethnic elements, though severally to a different degree. It does not even spare the European of unmixed blood as the Commissioners met with five cases representing three nationalities—German, French and English. Eurasians suffering from leprosy are frequently found. Since 1860, only two soldiers from the European Army have been invalided on account of leprosy and two have been admitted in the hospital for the same cause. On the other hand, the admissions on account of leprosy from the Native Army during the period of ten years, from 1879—1888, amounted to 229. No deductions can, however, be drawn from these figures, as the conditions under which the British soldier lives are entirely different from those of the natives.

There are in India no favoured races which are exempt from the disease, and it appears that the native element is undoubtedly more prone to the disease, and the unmixed European least. And the Commissioners are, therefore, of opinion that, *per se*, no one race is more liable to contract leprosy, and that, given equal and favourable conditions, all will be affected alike.

Leprosy in Relation to Religion and Caste.

(1) The census of 1881 shows the Kabirpanthis to be the most affected. We append the following table, which is interesting :—

Proportion per each Religion on 10,000.
(Census 1881.)

Religion.	Lepers per 10,000 of same Religion	Ratio of Followers of same Religion per 10,000 of entire Indian Popula- tion.	Remarks.
Kabirpanthis	7·7	14	
Buddhists	7·0	135	
Nat Worshippers ...	6·0	6	
Hindus	6·0	7,402	
Christians	5·6	73	
Muhammadians... ..	5·0	1,974	
Satnamis	4·3	16	
Parsis... ..	3·9	3	
Aboriginals	3·3	253	
Jains	2·2	48	
Sikhs	1·9	73	

The aboriginals are those who have hardly any religion at all, and who adore nature under the various forms or images they have chosen to select as representative of deity. Nine-tenths of the Buddhists are found in Burma, and hardly 200,000 can be found over the length and breadth of the continent of India. The Nats are entirely restricted to Burma. The Jains are to be found in numbers in Bombay, Rajputana and the North-West Provinces. They are very prosperous, and this may to a great extent account for the small amount of leprosy found amongst them. The Satnamis, who include a large number of agricultural Chamars, are found almost exclusively in Raipore and Bilaspore. They abstain from animal food and all sorts of intoxicating drink and drugs and are given to agricultural pursuits; but their ideas of cleanliness are capable of much improvement. The Kabirpanthis are chiefly found in the Central Provinces and in Benares, Bengal, &c., and they do not touch any spirituous liquors or flesh. The Sikhs, who show the least leper ratio, mainly inhabit the Punjab. They

are altogether, perhaps, the manliest and the finest set of men in the Empire. They abstain from tobacco, but take spirituous liquors and animal food, except the flesh of the cow.

The Sikhs and Jains are undoubtedly most exempt from leprosy, and the Parsis approach them closely in this respect. These three bodies are more or less select, the Sikhs representing the physically finest class of men, while the Jains and Parsis stand commercially highest, and belong to the wealthier portion of the community. Excluding the aborigines, leprosy is least found in the above and the Satnamis. The above facts seem to imply that where the religious belief is coupled with bad social conditions (as among the Buddhists and Nats) the leper ratios are highest; when favoured by exceptional surroundings, the proportion decreases considerably. Between these extremes are the Hindus, Christians and Muhammadans, and these may be said to represent the average population of India as regards personal and hygienic conditions.

(2) As to the relation of caste to leprosy, the Commissioners assert with confidence, from personal experience and inquiry, that no caste is exempt. According to the census returns of 1891, the various castes of the Punjab have been divided into three classes—the rich, the moderately wealthy and the poor. And it is found that the proportion of leper ratio per 10,000, for the rich stands at $\cdot 84$, that for the moderately wealthy it is $2\cdot 3$, and that for the poor it is $3\cdot 05$. This suggests that leprosy, like tuberculosis, has a certain predilection for people living under bad and more or less miserable conditions. Unfortunately, similar data for the rest of India are not available. It has already been shown that the poverty-stricken districts present higher ratios than the wealthier ones, and if the distribution of leprosy among the different castes should establish this connexion between the disease and bad, social or hygienic condition, the importance of individual predisposition is placed beyond a doubt. The few facts at the disposal of the Commission clearly point to the influence of poverty and its accompaniments or consequences on the distribution of leprosy.

Asylums and the Distribution of Leprosy.

I. From a table appended to this section, it is found that the existence of any asylum in a district does not become a centre of infection and a source of danger to the community. The statistical details of the three censuses afford sufficient evidence against the assumption of the spread of leprosy around an asylum as a possible centre of infection.

II. The increase in the number of inmates of an asylum has been used as an argument that leprosy is rapidly spreading in India. But it is hardly known that the asylum is to the leper as specially distasteful, and the fact that they resort to such asylums in numbers is more a test of their increased popularity than an evidence in favour of an increase of the disease. Just as the leper becomes more educated and recognises the advantages of such institutions, he naturally resorts to them. The Matoonga Leper Asylum at Bombay has been quoted by Mr. Tebb to establish the increase of the leper population in India. But nothing could be farther from the facts. The reason why many applicants were refused admission was not that the establishment of the asylum had suddenly sent up the ratio of the leper population in India, but because there was no further room to accommodate the applicants who had been attracted to the place as a home of refuge and rest.

III. The presence of an asylum in a district often attracts a number of lepers from neighbouring regions, and this is a point which must not be left out of sight when an inquiry is made into the leper density of a district. And the migration of lepers from Native into British territories is not at all uncommon. Whenever, therefore, a district shows a dense leper population, one of the points of inquiry must be whether an asylum exists in the locality, and how many of the inmates of such asylums have immigrated from outlying regions.

Leprosy and Vaccination.

Mr. Tebb, in his work on Leprosy and Vaccination, asserts that "the synchronicity between the spread of leprosy and the extension of vaccination has given rise, in some districts,

to such a dread of vaccination that every device is resorted to by thoughtful parents to prevent their children from being vaccinated." The history of leprosy in India does not bear out the assertion that such spread or recrudescence of the disease has taken place during the last 30 years. There is no hostility to vaccination in India, and if it does prevail in certain localities, it is due to the ignorance of the people and from *quasi*-religious motives. If it was ever known to the people that vaccination was the cause of the spread of leprosy, the opposition would have come soon after its introduction. As enlightenment and education advance, the native becomes more and more awake to the benefits conferred on him and his children by vaccination. In not a single instance did a leper accuse vaccination as the cause of his misfortune, although the Commissioners inquired in every case into the theory a patient might offer for the development of his disease.

Anti-vaccinationists are not aware of the fact that the methods of vaccination employed in India are various, and that arm to arm vaccination can alone, if it at all does, transmit leprosy by human lymph, whereas the latter mode is hardly extensively practised. In the City of Bombay calf-lymph is extensively used. In Madras, Bengal, Assam and Burma, the Government has determined to introduce vaccination by the same method. The conditions necessary for transmitting leprosy by vaccination are, that the person from whom the lymph is derived must be a leper, and this must be an extremely rare occurrence in case of infants and children, and that the person vaccinated from or after a leper must be in the proper state or predisposition to be infected with leprosy. Again, if a leper presents himself for vaccination, there can be hardly any doubt that the most neglectful operator would be the most careful in the performance of his duty.

Vaccination is yet by no means generally introduced into India, and at the present time even less than ten per cent. of the whole population are so protected. During the year 1889—1890, of 199,638,558 individuals, only 2·9 per cent. were vaccinated, and this ratio has never been exceeded since

the institution of vaccination. Of the six millions vaccinated in India during 1889—1890, about five millions were infants. The death-rate of infants is extremely high, and has always been so. Considering, therefore, that since the institution of vaccination never more than three per cent. of the total population have been operated upon during any one year, that of this number more than 75 per cent. are always infants, and that the mortality among the latter is very high, it is by no means improbable that at the present time less than ten per cent. of the total population in India are actually vaccinated. Whereas in England, 82·8 per cent. of the total number born are successfully vaccinated; in India the average comes to about 30 per cent.

The following points are worth noting :—

(a) Leprosy is not a disease which, like syphilis, can easily and with certainty be transmitted by a single inoculation.

(b) As about 30 per cent. are annually successfully vaccinated in the first year of the birth, and not more than 40 per cent. within the first six years, and taking the averages of the whole of British India, it is found that only about two-and-three-quarter millions expose themselves to the possible risk of acquiring leprosy by means of vaccination.

(c) To be infected these children must have been vaccinated from a leper child, and it must be noted that it occurs in one out of 100,000 cases at an infantile period.

(d) Lastly, the error of using lymph from a leprous child, especially as the disease is easily recognised, must occur extremely seldom.

The chances, therefore, of leprosy being spread in this manner must be very small indeed, if at all conceivable. Vaccination is becoming more popular every year, and yet leprosy has not increased, but rather decreased since the last enumeration; that recrudescence “assumed by many has not taken place so far as the census figures show; whereas the same figures have been brought into evidence by those who condemned vaccination or clamoured for compulsory segregation.”

Surgeon-Major Pringle states that during twenty years he was Deputy Sanitary Commissioner in the North-Western Provinces, he had vaccinated about two million persons, but he had never seen a case of leprosy traceable to vaccination, and had never heard of its happening, though the natives of those districts were ready with objections and reasons for not having their children vaccinated. He moreover vaccinated children in a district, where leprosy was comparatively rare, with lymph brought down from a district where leprosy was many times more common, and yet the former showed no increase of the disease. If vaccination were responsible for spreading leprosy, an increase of the disease in this particular part of India might justly be expected. But the returns show the proportion of lepers has remained stationary, if not increased. The Commissioners conclude that the *onus probandi* rests with those who attribute the alleged increase of leprosy to vaccination without the least knowledge of the methods employed, and without any positive proof that leprosy is capable of being transmitted by such a form of inoculation as is implied in vaccination. Until a series of positive cases free from all doubt and objection can be demonstrated, the statement that leprosy is diffused by vaccination must be regarded as devoid of scientific value.

Finally, it may be safely stated that from a hundred thousand to one hundred and five thousand would fairly and accurately represent the leper population for British India.

From the consideration of the leper distribution according to the three censuses, it is evident that the alarm about the increase of leprosy in British India is altogether groundless ; in fact, that the figures available, unfortunately consisting only of three sets, points strongly to a decrease among these unfortunate people, in any case to the disease being at a standstill. Again, the number of lepers has been greatly overstated, a hundred and ten thousand being, perhaps, nearest the truth. Leprosy cannot, therefore, be regarded in the light of an "Imperial danger."

Hereditary Transmission and Predisposition.

There is as little consensus of opinion as to the hereditary transmission of leprosy from parent to offspring as there is with regard to the contagiousness of the disease. Some, like Liveing, believe in an hereditary predisposition; some, like Danielssen and Boeck, maintain that hereditary predisposition and transmission are the chief causes of the perpetuation of the disease in Norway; whilst others, like Leloir and Hansen, deny in toto any such transmission or predisposition. Hansen visited North America to inquire into the condition of the descendants of 160 Norwegian lepers who had emigrated to that country, and he found that only 17 of the original emigrants were alive, and that not one of the descendants of these men had contracted leprosy. Virchow believes that only the predisposition and not the disease itself is transmitted. Dr. Vandyke Carter, in his well-known work, strongly urges the spread of the disease through hereditary transmission, and Drs. Lewis and Cunningham hold that the hereditary taint exercises a most important influence in the transmission of the pest.

The difference of opinions is due to the fact that no clear distinction has been drawn by the authors between hereditary transmission of a disease and inherited predisposition to a disease. Again, where a family taint is possible, they have not inquired into the time at which parent or parents were affected. The mere facts of parent or parents being diseased is not enough, but it is essential to inquire if the child was born after the parents had become diseased or before. In the latter case there could be no transmission of predisposition.

After due consideration of all the evidence obtained by means of an examination of over two thousand cases, the Commissioners have come to the conclusion *that leprosy in India cannot be considered an hereditary disease, and they would venture to say that the evidence which exists is hardly sufficient to establish an inherited specific predisposition to the*

disease by the offspring of leprosy parents to any appreciable degree.

Before discussing the facts from which these deductions have been drawn, the Commissioners make a few general remarks on the subject of hereditary transmission and predisposition, and illustrate the same by examples derived from the knowledge of tuberculosis which resembles leprosy in many respects.

Tuberculosis is essentially a disease of extra uterine life, and, though hereditary in certain instances, it is not so as a disease, but as a predisposition. Although two cases are reported in which the disease seems to have been transmitted to the foetus in utero, a distinction must clearly be drawn between a congenital or hereditary disease and an infection from the parents through the placental circulation of the child.

When the influence of heredity in a disease such as leprosy is under discussion, and it is known or proved that the disease itself is not the thing transmitted from parent to child, but only the predisposition to it, great care and caution must be exercised in finding out how far in each case the congenital predisposition has not only been inherited but also inherited in a legitimate manner. This predisposition which is necessary for the disease to appear both in leprosy as well as in tuberculosis may be due to many agents and factors, and it may therefore be quite possible that the factors which produced the predisposition in the parents, quite apart from the resulting leprosy, may be the cause of the congenital predisposition transmitted to the child. But this could not be called a legitimate inheritance. When practical questions regarding heredity are under consideration, which may result in the separation of husband and wife or interdiction of marriages between the affected, it is of the utmost importance to study the influence of the disease itself in causing a specific predisposition in the offspring. The fact that in tuberculosis as well as in leprosy the disease occasionally escapes a generation speaks strongly in favour of a more

general than specific form of inheritance, and hence also the possibility that a non-tubercular or non-leprous condition of the parents may cause the predisposition in the child necessary for the development of tuberculosis or leprosy, as the case may be.

When in tuberculosis different members of the same family suffer, say—one from tubercular arachnitis, another with tubercular arthritis, or a third with laryngeal phthisis, this does not in any way prove the existence of a dyscrasia, but shows that the exciting causes select one or other part, and that several areas of the body are in the same predisposed condition. The same *mutatis mutandis* applies to leprosy, and when it is remembered that a predisposition may just as easily be acquired, it is felt that great stress may be laid on the external surrounding conditions, and hence it is necessary to carefully exclude the influence of such agencies in order to study the effect of a specific hereditary predisposition pure and simple. The fact that a near relation had leprosy is not sufficient to prove the congenital predisposition which can only be said to have been thus properly inherited if the child was actually born of a leprous parent. If born of a parent who some years and frequently many years after the birth of a child becomes a leper, this child cannot possibly be supposed to have inherited a specific leprous predisposition in a legitimate manner. The fact that the parent eventually falls a victim to the disease cannot make the inherited predisposition any more specific or legitimate. This can only prove that certain conditions and abnormalities of the parent, which eventually lead to the establishment of a predisposition capable of being acted upon by the exciting causes responsible for the development of the leprosy, have been transmitted to offspring.

In investigating this subject, it is essential therefore to enquire into the condition of the children born of leprous parents, and then it must be seen whether the specific inherited predisposition in them has a greater influence on the development of the disease than a non-specific congenital

predisposition ; if the former, separation of husband and wife and interdiction of marriage would be necessary ; if not, the solution of the question must direct itself to the amelioration of the general external conditions.

These considerations have guided the Commissioners in all the subsequent argument in these questions.

I. A case was never seen of a child leprous at the time of birth or so shortly afterwards that it might fairly be considered a congenital case. This is obviously fatal to the conception of an hereditary transmission, and it is important to keep this in view in the investigation of a disease of bacillary origin, for it is easy to conceive that the ovum or embryo could be invaded by the bacillus. Although this tells against the hereditary transmission of the actual morbid condition, still it might be assumed that some constitutional defects casually related to the leprosy of the parents is set up in the embryo which subsequently, under favourable conditions, gives rise to the disease. But the Commissioners state that other facts, while still further disproving hereditary transmission, cast doubt also upon the possibility of an inherited specific predisposition.

II. How often is it possible to trace a family taint in the direct line from parent to offspring ? If the facts available with regard to family taint in the direct line be not sufficient to establish inheritance, then *à fortiori* arguments from collateral relationships must be altogether without force. Dr. Vandyke Carter found from information collected in the Bombay Presidency that about 20 per cent. of lepers had a family taint. But in 14.5 per cent. of these, the taint was in the collateral line, including cousins. From these hardly any thing could be argued. "Atavism" has been included by some in support of the theory of heredity, but the Commissioners are of opinion that atavism can have no place in ætiology of leprosy.

Collateral and distant relationship may consequently be disregarded and the enquiry may be restricted to the number

of instances in which a family taint could be ascertained in direct lines of descent. It is found that amongst 2,371 lepers examined by the Commissioners, 264, that is 11·1 per cent., had a family taint irrespective of the fact whether the parent or parents were leprosy at the time the child was born, and 130 cases, that is 5·48 per cent., in which the parent or parents were lepers at the time of the birth of the offspring. It will be seen, therefore, that in 5·48 per cent., only hereditary taint in the direct line could be traced. In 74 cases out of the 130 either no statement was made as to the condition of parent or parents at the time of the child's birth, or some doubt was expressed as to diagnosis, and allowing for this, it would perhaps be nearer the mark to say that a true family taint in the direct line could be established in about 4 per cent. of the cases seen. Family taint in the direct line is therefore established in only a few cases, and consequently, as far as these figures go, one is forced to look for other and more potent causes for the origin of the disease.

These facts and figures tend to confirm Hadsen's disbelief in an inherited specific predisposition and as the importance of the inheritance as an ætiological factor vanishes, so that of external conditions must rise into prominence. And parent and child being subjected usually to exactly similar surrounding conditions and circumstances, it is well within the bounds of probabilities that the disease has started *de novo*, unless the influence of external causes can be excluded, and inheritance proved in majority of cases and on sound evidence the hereditary transmission of specific predisposition to a disease cannot be said to establish. The great importance of external conditions in the ætiology of leprosy must be admitted, and the figures therefore tend to reduce the importance of inheritance so greatly, that practically it may be altogether disregarded.

If heredity has any appreciable influence on the spread or origin of the disease, it should be possible to trace leprosy through several generations in a sufficiently large number of cases. It was found, after careful enquiries among those

in whom a family taint in the direct line was acknowledged, that only 18 cases could be obtained where the disease could be traced from the grandfather or grandmother downwards. In 5 of these cases the statements were insufficient or the diagnosis of the leprosy doubtful; and in 6 cases the children were in each instance born of healthy parents, so that the conditions are such as to exclude an inherited specific predisposition.

If heredity exercised any appreciable influence on the spread of leprosy, it should have been possible to obtain a far greater number of cases where the disease could be traced through two generations at least, but according to the figures above quoted, the ratio could be less than 1 to 100. If a predisposition has been transmitted to the child in some of the above cases, it must have been the physiological or anatomical conditions which have rendered the ancestor a favourable subject for the *de novo* acquisition of the disease, but it is certainly not a legitimate inheritance of a leprosy predisposition. For whatever the child inherited, it would have inherited whether the parent subsequently became a leper or not.

On excluding contagion, it might be quite possible that in all members of the family the disease started *de novo*, the necessary predisposition having been acquired. To allow such cases as proofs of an inherited predisposition would obviously be a "post hoc ergo propter hoc" argument.

III. From the fact that leprosy occurs often in several members of a family, authors have argued the existence of a specific hereditary predisposition. This does not hold good from the fact that cases occurred where two or three brothers or sisters simultaneously suffered without there being any leprosy taint in the ancestors. If it can be shown with sufficient frequency that several children become affected while the parents remain healthy, this coupled with the small percentage of direct family taint found in the present enquiry would still further diminish the importance of heredity as a cause of the continuance of a disease. In 101 instances, or

in about 4·5 per cent. of the cases examined, it was found that two or more children became lepers while their parents were perfectly healthy, and in most of these cases no other relative was affected. Heredity is of course excluded here, and atavism cannot have any part, and hence the conclusion is strongly suggested that though the disease in a small proportion of cases appears to remain in families, this cannot be ascribed to a specific inherited predisposition.

IV. Perhaps the best method of studying the influence of heredity is to enquire into the condition of the children born of leprous parents, the latter having been lepers since their marriage. From the table given in the report it is seen that 98 leprous couples representing 188 individuals had 65 children, and of these three became lepers and two cases were exceedingly doubtful. Thus it is found that 4·6 per cent. or, with the doubtful case, 7·6 per cent. of the issue of the leper marriages have contracted the disease. These figures are almost identical with the previous ones. In these cases the most favourable conditions for the full play of inheritance existed, and nevertheless the actual percentage of hereditary cases is less. If a specific hereditary transmission exercised any considerable influence, a much greater number of the 65 children should have become affected. Of these, the majority are adults perfectly healthy, some married and with healthy children, a certain number on the other hand died healthy. These figures therefore give little support to the views of a legitimately inherited predisposition to the disease.

V. The Commissioners suggest that the only way in which the influence of hereditary and external conditions could be disentangled would be to imitate the experiment of the emigrant Norwegian lepers, and to remove the offspring of lepers not only from the parents but also into an area where leprosy is not endemic. Placed under such conditions with good food and hygienic surroundings, heredity would have full and absolute play.

There are two such asylums in India where children born of leprous parents are kept apart from them and tended with

great care—Almora and Purulia. The Almora Orphanage has been long in existence, and in 1877 Drs. Lewis and Cunningham saw twelve children of lepers who were all healthy showing no signs of leprosy ranging from five to nineteen years of age. The Commissioners examined twenty-three inmates of the orphanage. Of these, three were born before the manifestation of the disease in the parent, their ages being 31, 28 and 19 respectively, and five were under 10 years, their ages ranging from 7 years to 6 months (7, 7, 4, 3 and $\frac{1}{2}$ years respectively). All these eight individuals were up to date in good health. Of the fifteen cases, only one had contracted the disease, all the others having remained perfectly well or having died free from leprosy in adult age. This gives an assumed hereditary transmission ratio in 6·6 per cent.

VI. In the fourth section the condition of children born of two leprous parents was enquired into. In this section the condition of all the children born after the manifestation of the disease in one or other parent is considered. It was found that among 500 children of all ages born either of two leprous parents or from one leper parent and one healthy parent, 21, or 4·2 per cent., became lepers. Excluding two doubtful cases from these and accepting nineteen as the actual number of the offspring attacked, the ratio yielded very nearly approaches the truth. These are again arranged in two classes: (a) all those of 10 years and over; (b) all those of 16 years and over. In the former there were 150 individuals born after the appearance of the disease in the parent or parents, and of these 10 had become lepers, or 6·6 per cent.; in the latter there were 82, of which 6 became lepers, or 7·31 per cent.

VII. The influence of an inherited specific predisposition may be studied by the selection of cases in which a family taint in the direct line can be traced and by an enquiry into the conditions of brothers and sisters. For this reason the term "false heredity" is introduced, and refers to such patients who were born of fathers and mothers absolutely healthy, though they afterwards became lepers: whereas true heredity refers in these cases to all those born of leprous parents. In the report

tables are constructed with a view to show how many of the brothers and sisters of lepers with a "false" hereditary history have become lepers in comparison with the number of brothers and sisters with a "true" history who have become lepers, and these throw an additional light upon the influence of heredity. They show that 62 patients with a true hereditary history had 156 brothers and sisters born also, as far as could be ascertained, after the manifestation of the disease in their fathers and mothers; and of these, 21 became lepers, 13·4 per cent. Sixty-one patients with a history of false heredity had 151 brothers and sisters, and of these, 31, or 20·6 per cent., were lepers. This is a most surprising result, and if coupled with the number of instances of several children becoming lepers while their parents remained healthy, removes the importance attributed to a specific hereditary predisposition. The only inference to be drawn from these facts is that leprosy appears to have a tendency to attack several members of a family, but that a legitimate specific hereditary transmission cannot be regarded as a cause. Whether contagion can explain this fact will be considered later on; but it should never be forgotten that a disease due to extraneous agents and conditions, as leprosy seems to be, may at any time affect people living in similar surroundings and possessing similar constitutions, and which can be found only amongst the members of a family.

From the tables showing the conditions of brothers and sisters with "true" and "false" hereditary history, it might at first sight lead to the belief that the children born of lepers or of parents who became lepers at any time after the birth of these children suffered more frequently from leprosy than do the children born of people remaining free from the disease. To enquire into the truth of this statement another table has been added to show the conditions of the brothers and sisters of leprous patients born of parents healthy before and after the birth of such patients. It has been found that 850 patients had 2,853 brothers and sisters, of whom 97, or 3·4 per cent., subsequently contracted leprosy. On the other hand, 123 patients with a history of "true" or

"false" heredity had 306 brothers and sisters, of whom 52, or 17·0 per cent., subsequently became affected.

Does this prove a specific hereditary influence of predisposition? A comparison of the tables with false heredity with the last in which the parents have been always healthy can evidently only prove this, that in those families where a parent becomes a leper after the birth of his children, and where also at least one of the children subsequently becomes a leper, the children, as a whole, are more liable to suffer from this disease. Similarly a comparison between the table of true heredity with the same only shows that in those families, where at least one parent is a leper before the birth of his children, and where also at least one of these children subsequently becomes a leper, the children, as a whole, are somewhat more liable to suffer from the disease than the children in those families where the parents are healthy, and remained so, while at least one child is a leper.

But clearly all this does not prove anything in favour of a specific hereditary predisposition casually related to the leprosy in the parent. In fact, it argues strongly for an acquired predisposition both by the parents and the children, and this, in the case of the latter, may have been facilitated by some congenital abnormality not related to leprosy, but inherited from the former.

It is found that in those families where the parents were healthy, but one child at least a leper, of 3,703 children, 947, or 25 per cent., became lepers, though the parents, as far as could be ascertained, were free from the family taint in the direct line. If these figures are compared with those of such families where parents remained healthy and were confessedly free from the family taint in the direct line, but at least two of the children were lepers, it was found that in such families 96 patients had 292 brothers and sisters, of whom 111 were lepers, or, in other words, in these families of 388 children, 207, or 53·3 per cent., were diseased. Here any hereditary specific predisposition is excluded as rigorously as

possible, and yet the disease shows a predilection for certain families.

It is only when examined in this light that deductions regarding the offspring, as a whole, can be made with a view to elicit the influence of a specific hereditary predisposition. Now, as individuals of alien blood such as husbands and wives of lepers who live with a family under similar conditions suffer to the extent of from 5 to 6 per cent., the above arguments are strengthened. Evidently all that can be argued from these considerations is that leprosy in a certain number of instances has a tendency to affect several members of a family, but that this is not due to a specific hereditary predisposition.

VIII. The next point considered by the Commissioners relates to the risk, if any, of increase to the leper population assuming heredity to be a more or less influential agent in the spread of the disease. Drs. Lewis and Cunningham, who went into the subject, came to the conclusion that there appeared to be no great risk of increase to the leper population of Kumaun as far as the disease is dependent on heredity for its multiplication. From a table in the report it is found that 2,447 children were born to married couples before the appearance of leprosy in parents, and 468 children were born after the appearance of the disease, and thus 2,915 children in all have been the issue of 1,564 marriages. Of these, 71 were contracted by individuals both suffering from the disease. So that these would represent 142 lepers. Of the rest, the number of marriages were contracted between a leper and a healthy person amount to 1,493. This number added to 142 gives a total of 1,635.

These 1,635 lepers would be replaced by 2,915 children. Therefore, 1,635 lepers have contributed a permanent addition of 1,280, for 1,635 of the children must be deducted as merely replacing their leprous ancestors. All these children would not become lepers. At present only 78 of the children are affected, many of them are yet too young to show any manifestation

of the disease, but may do so at a more advanced age, and a certain proportion of them are adults and married and have healthy children. Taking everything into consideration, it is unlikely that more than 5 per cent. of the 2,915 children will become lepers. This would indicate that of the total number of children born up to the present, 145 only are likely to become lepers through the agency of heredity. Hence a leprous population of 1,635 individuals may be expected to transmit the disease to 145. This is, however, too high a ratio, and the Commissioners believe that about 80 of the children would become lepers through the assumed influence of heredity.

Thus, there is no danger of a spread of the pest by hereditary transmission and predisposition. In fact, the figures show conclusively that not only could there be no increase to the leper population by means of this agency, but that all other causes being removed, the disease must die out, and the Commissioners do not find it astonishing on the strength of this data, that the disease should have been practically extirpated amongst the community like the above-mentioned Norwegians who forsook their own country and wandered into fresh areas and surroundings apparently out of reach of the factors capable of originating the disease.

IX. Amongst other causes that operate powerfully against the possible risk of increase in the leper population must be mentioned the diminished procreative power of lepers and the comparatively high mortality among their offspring. There is no doubt that a certain number of children born of leprous parents are short-lived.

The reproductive power of the leper is diminished on account of extensive morbid changes in the sexual glands in the male and on account of a leprous ovaritis in the female as demonstrated by Arning. It has been shown that the issue of 98 marriages between two lepers amounts to only 65, and that of 85 couples no less than 55, or 64·7 per cent., were sterile. Hence, assuming all the 65 children to live and grow up according to these figures, 168 lepers would be re-

placed by 65 persons, that is, there would be an actual decrease of 62 per cent. in such a population. Assuming that 5 per cent. of the 65 children became lepers, it seems that 168 lepers would be replaced by 3 or 4 lepers, or if the diffusion of the disease depended on heredity only, there would be an actual decrease of almost 99 per cent. in the leprous population. From these figures the following conclusion can be drawn :—

- (a) There is no evidence that marriages among lepers in any way *per se* increase the risk of diffusing the disease as far as heredity is concerned.
- (b) Even allowing the latter the fullest play and setting aside all other causes of leprosy, the disease would gradually die out in them. Intermarriages, therefore, amongst lepers cannot be regarded as harmful to the community or as calculated to spread the disease so far as this depends upon hereditary transmission or predisposition.

The next point to be considered is in the case of marriages between a healthy person and a leper. It has been found that in such marriages where the husband only was a leper, of the 296 couples, 176, or 59·4 per cent., had no issue after the appearance of the disease in the husband, while the progeny of the 120 non-sterile couples amounted to only 249 individuals, that is, the average number comes to less than one per couple.

Of 88 couples where the wives only were affected, no children were born in 62 instances after the manifestation of the disease, the total number of children born to the diseased mother amounting to 49. Thus, 70·4 per cent. of the women became sterile with the appearance of the disease, and the average number of children to each is considerably less than one. These statistics, though they cannot represent the absolute truth, at least justify the belief of loss of procreative power casually related to leprosy and tend to diminish the fear of a diffusion of the disease through marriage with lepers.

From all these considerations, then, it may fairly be concluded that marriages among lepers, and with lepers, do not increase the risk of a diffusion of leprosy by means of the offspring, and that this to a great extent is due to the relative sterility of lepers, whether males or females.

The Commissioners then summarise and state that they have come to the conclusion that there is *no evidence that leprosy in India is transmitted through heredity from parent to child, their reasons being—*

- (1) no authentic congenital case has ever been put on record, nor was one seen in this country ;*
- (2) true family histories of leprosy could be obtained in only 5 or 6 per cent. of the cases ;*
- (3) many instances occurred of children being affected while their parents remain perfectly healthy ;*
- (4) the percentage of children, the result of leper marriages, who become lepers, is too small to warrant the belief in the hereditary transmission of the disease ;*
- (5) the facts obtained from the Orphanage at the Almora Asylum disprove the existence of a specific hereditary predisposition ;*
- (6) only 5 or 6 per cent. of the children born after the manifestation of the disease in the parents become subsequently affected ;*
- (7) the histories of the brothers and sisters of leper patients with a true or false hereditary taint seem to show that little importance can be attached to inheritance as an agent in the perpetuation of the disease.*

For the same reasons it may be assumed that the specific hereditary predisposition to leprosy is but slight and practically does not exist.

Lastly, it has been shown that taking all the information obtainable, and even allowing the fullest influence to heredity, there appears to be no risk of an increase to the leper population of India so far as the disease is dependent on heredity

for its multiplication, and that marriages with or intermarriages between lepers cannot be regarded in the light of a danger to the community.

Contagiousness of Leprosy.

All modern authorities are agreed that leprosy is an infective disease, that is, one caused by a microbe, the bacillus lepræ, which obtains access to the body from without and subsequently multiplies within the organism, calling forth the characteristic lesions. The next point to be considered is, whether or no leprosy is contagious. All diseases due to a pathogenic germ are not necessarily contagious, *e. g.*, malaria and pneumonia.

Opinions differ widely as to the contagiousness of leprosy. Flügge says that the diffusion of leprosy by contagion is exceedingly rare, and evidently can only take place under special and predisposing conditions.

The Commissioners premise by stating that the more weight is attached to special favourable conditions, in fact, what in clinical language is called "the suitable nidus," the further contagion disappears into the background, and for all practical purposes it vanishes altogether.

Hansen, however, believes in contagion, and so also does Leloir. According to Virchow, leprosy does not spread by contagion, though it may scientifically be correct to classify it amongst the contagious diseases.

Before entering into a discussion on this point, the Commissioners offer a few general observations as a guide to other inquiries:—*Firstly*, in considering contagion, the abstract and scientific meaning of the term must be separated from the practical. *Secondly*, the connotation of the term infection must not be misconstrued or unduly extended.

If a disease is called infective, it means that it may be transmitted from the affected to the healthy individual; but it does not show the way in which it naturally diffuses, nor as to the way and how far it is transmitted under ordinary

conditions. The natural mode of transmission of an infective disease depends on the faculty pathogenic germs possess of leaving the body of the diseased in the full possession of their power of setting up an infection. If they be thrown off from any surface of a diseased organism in sufficient quantity and in a sufficient resistant state, a transmission of the disease from the affected to the healthy person *may* take place, and the diffusion of the disease in such cases under certain conditions *may* be effected through contagion. *Again, if the germs or spores are widely distributed throughout space, the risk of contagion may be disregarded. If, however, the germs reproduced in the body of the diseased person never leave the latter, or only do so without possessing the power of causing subsequent infection, the infective disease caused by such germs is non-contagious.* The germs in such cases must have a place somewhere whence they can always *de novo* attack the healthy organism.

The degrees of contagiousness of infective diseases differ greatly, depending partly on the unequal liability of the healthy body to be invaded by germs, and partly on the resistance and quantity of germs leaving the diseased body. Again, the channels of infection might not offer a suitable soil for the growth of the germs, and, finally, the human body may possess protective means offering obstacles to the attacking germ. A disease may thus scientifically be grouped amongst the infective and contagious diseases, and yet practically and clinically hardly deserve the name. The Commissioners regret that, without in the least underestimating the importance of bacteriological and animal experiments, the modern advances in these have led observers to take a one-sided view to the disregard of the evidence derived from clinical and epidemiological experience. They state that the bacteriologist, in experimenting upon highly susceptible animals, easily runs the risk of arguing beyond his premises and of drawing conclusions from his experiments, which he applies without sufficient reserve to the natural mode of infection. And, further, they believe that it is quite impossible for bacteriology alone, without the aid of clinical

and epidemiological observations, to deduce the ætiology of an infective disease. A susceptible animal may easily be infected by experiment, and yet the case may be quite different with man. They illustrate the above arguments by citing tuberculosis. The tubercle bacillus is widely distributed throughout space without any loss of vigour; but tuberculosis is not so extensive in proportion, because the conditions necessary for its multiplication and proliferation do never exist in the ordinary human surroundings. Its diffusion depends on its transmission from one individual to another, and, secondly, on the fact that the bacilli may remain dormant in full possession of their virulent properties for a considerable time without ever showing any signs of proliferation. They are, in fact, true parasites. From these facts one would be inclined to assume that tuberculosis must be a highly contagious disease. But it is by no means so. Healthy persons living in the immediate neighbourhood of phthisical patients by no means all become infected, or perhaps, only slightly more than if the chances of infection were less. This is due to the disposition of an individual which, according to Flügge, governs the mode of diffusion of tuberculosis. The Commissioners state that the introduction of the bacillus into the human body is not sufficient to bring about the infection without the necessary individual predisposition.

The causes and nature of such predisposition may be unknown, but that it exists no one denies, and its bearing on contagion is evident.

The Commissioners have, from their observations, come to the following conclusion, that *though they consider leprosy an infective disease, caused by a specific bacillus, and moreover also a contagious disease, they are of opinion that there is not sufficient evidence that leprosy is maintained or diffused by contagion; indeed, under the ordinary human surroundings, the amount of contagion which exists is so small that it may be disregarded, and no legislation is called for on the lines either of segregation, or of interdiction of marriages with lepers.*

The Commissioners deduce the following arguments against a contagion which they deem worthy of practical consideration:—

I. All the cases brought forward and demonstrated to the Commissioners as instances of contagion have broken down with one possible exception. Now, it seems very significant that the cases which were supposed to prove the contagion theory, and on which such theory was really based, almost entirely collapsed.

II. In not a single case could contagion, or the possibility of contagion, be actually demonstrated in a manner free from objection. Statements from patients of their having sometime or other come in contact with lepers have led some authors to assume a long incubation period of the disease. But it is a question whether it is still possible to talk of contagion after an incubation period which, in many instances, must have extended over ten or more years. At any rate, contagion seems incompatible with a disproportionately long and latent period, and the more so when the person affected has been living all these years in an endemic area.

Special attention was paid by the Commission to the effect of people eating with lepers. A table shows that 79 lepers ate and drank for some time out of the same vessels with two hundred and five healthy people, and of the latter 7 per cent. afterwards became lepers, and all these cases occurred in families. But it has been previously shown that leprosy has a tendency to appear in families, not because of any hereditary transmission or predisposition, but most likely from the fact that the members of a family are more likely to be subjected to the same abiding external causes. Even if these cases be free from all objections as regards contagion, they do not show any great influence of contagion.

III. In a family, contagion has, of course, the widest play. However, it has been found that the disease does not spread sufficiently amongst the members of one family to warrant the conclusion that it is contagious to any extent.

IV. Again, when the intimate intercourse between man and wife is considered, it is astonishing how seldom the wife "catches" the disease from her husband or *vice versa*. Yet it is well known that bacilli may easily be found in the spermatic fluid, and here, then, there is an opportunity offered for oft-repeated inoculation through the mucous membrane of the genital tract. Yet a case is hardly ever found where *bona fide* the disease may be assumed to have spread from husband to wife.

V. Vaccination has been mentioned as affording a risk for diffusing leprosy ; but this is not borne out by facts ascertained in India. *Firstly*, the number of persons actually vaccinated in India is very small in comparison with the general population. It appears that out of 7,985,543 children available for vaccination in British India in 1889, only 2,178,464, or 27·2, were vaccinated. *Secondly*, a considerable number of these were vaccinated from the calf. *Thirdly*, where arm-to-arm vaccination is practised, lymph is taken from the vaccinifer at an age when leprosy rarely occurs. *Fourthly*, it is highly questionable whether such inoculation as vaccination implies would be able to produce the disease in another person even granting that the vaccinifer were a leper and that the lymph contained bacilli. *Lastly*, three of the Commissioners vaccinated a number of lepers over healthy and affected areas and examined the lymph and crusts for leprosy bacilli, but without any result. Of 93 specimens, only 6 were slightly suspicious. It has been ascertained by experiment that if a blister be raised over apparently healthy skin, its serous fluid will be quite free from the bacilli, while in blisters raised over leprosy nodules, bacilli may in some cases be found. And surely, no one would ever think of vaccinating an individual over a tubercle or diseased part, or if he did so, would employ such lymph to vaccinate another individual. The practical danger, therefore, of leprosy being diffused in this manner, even supposing the disease to be highly contagious, is minimal. The instances quoted in literature like those of Gairdner and Daubler, of leprosy being "vaccinated" on to a healthy child are too

equivocal and ambiguous to carry much weight. It is only in vaccine lymph over extensive cutaneous leprosy that the bacilli are found, and hence vaccinators would hesitate to vaccinate from such a person. From the above it is evident that practically there is no risk of a diffusion of the disease in vaccination from arm-to-arm.

VI. Attempts were made to inquire into the possibility of a leprous community becoming or acting as a centre whence the pest might be diffused among the population. The Census returns present strong arguments against such a spread of leprosy.

At Tarn Taran the lepers inhabit a separate quarter of the town in continuity with the rest ; but leprosy does not seem to have in any way become diffused among the healthy population, although this leper quarter has been in existence for many years. It is an almost universal opinion of scientific and intelligent men in India that a spread of the disease has never been known to take place from a leper centre to its neighbourhood.

VII. It is believed in some parts of India, especially in the hill tracts, that those who go barefoot are liable to be directly inoculated with leprosy through wounds or ulcers of the feet. Earth from the paths and banks in the Almora Asylum compound was examined by the Commissioners. Only ten leprosy bacilli were found in 100 cover-glasses, but at present no criterion of a living leprosy bacillus exists, and the fact that such a small number was found in an extended series of observations and on the most favourable material would suggest that, though the danger of individual inoculation is possible, the risk of the diffusion of the disease in this manner is very slight. An examination of the dust from huts inhabited by lepers and afflicted with ulcers on their feet and hands did not result in the discovery of any bacilli, nor were they found in the earth or air in the rooms of lepers.

VIII. The Commissioners met with many cases where people had lived in asylums with lepers often eating and drinking with them or smoking with them, perhaps at-

tending to their wants and ailments, and yet remaining perfectly untainted, often after many years of such association. The value of this negative evidence is highly instructive in throwing light on the practical dangers of contagion, and is of importance in the absence of an actual positive case of contagion free from all objection. Such a case up to the present does not exist. Of one hundred and four persons living with lepers in asylums under the most favourable conditions for contracting a communicable disease, only one or possibly two became lepers.

The Commissioners summarise and state that the arguments advanced by them against contagion possess no novelty. But in India no others are obtainable, and as experiments cannot be made on man, and as those on animals cannot be entirely relevant, they have had to fall back upon deductions drawn from clinical evidence. Clinical evidence for India is strongly against a measurable contagiousness of leprosy, and they further state that all that has been said of tuberculosis may be applied equally to leprosy.

The individual disposition plays just the same important part in leprosy as in phthisis. With the assumption of such disposition, the practical importance of contagion is reduced to a minimum, and it becomes the duty of a reformer to find means to prevent and counteract this disposition in leprosy just as it has become an almost general practice to counteract nearly exclusively this individual disposition in tuberculosis. As stated previously, the disease must be classed amongst the contagious diseases. But it must not be forgotten that contagion is but a relative term, and that where reforms and similar measures are under consideration, the actual and concrete influence of contagion is a factor to be considered, and this has been shown to be as small as or even rather less than in the case of tuberculosis.

In an appendix to the chapter on Contagion, the Commissioners append a number of tables from which they have drawn the foregoing arguments against the contagiousness of leprosy.

With regard to the case related by Surgeon-Major W. K. Hatch of Bombay, in which it was thought that a student has accidentally infected himself during an autopsy on a leper, and which was widely quoted as an example of the inoculability of leprosy, the Commissioners say that the first symptoms were indeed very suspicious. But they are of opinion that the further progress of the case as related by Dr. Hatch entirely negatived the original diagnosis of leprosy.

In two cases in which the wife was supposed to have contracted leprosy from the husband, the examination showed that the woman was not a leper at all, while in four out of five cases in which asylum attendants were supposed to have been infected by the inmates, the former were shown to have been lepers before they entered on their duties, and lastly only one case of contagion has not utterly broken down.

Of 1,691 healthy people living with 719 lepers, 95, or about 5 per cent., were affected with the disease ; but diagnosis was doubtful in 17 cases.

Of 381 married couples living together, one of each couple being a leper, 25 subsequently became affected, or 6·5 per cent. Deducting 6 cases from these, the ratio stands at 4·9 per cent.

In 222 couples, of which one individual became a leper and continued to live with the other for a period of less than five years, only 5 became tainted, or 2·2 per cent.

Of 69 asylum officials, only 3 were affected with leprosy. Of these, one had the disease before he entered the service, and a second case is doubtful, so that actually only one out of 69 had become tainted, or 1·5 per cent.

Of 35 healthy persons living in intimate contact with lepers in the asylum from a period varying from 28 years to 1 year, and all personally examined by the Commission, not one was affected.

*Sanitation, Diet and Diseases in relation to Leprosy.**Sanitation.*

In this section the Commissioners discuss the more important causes supposed to bring about that peculiar specific predisposition which is necessary to the development of leprosy in any individual, and whether defective sanitation can cause a specific predisposition to leprosy. A general review is then taken of the prevailing sanitary and insanitary conditions existing throughout India, in large cities and in smaller towns and villages, and they state that no large centre of population is free from any nuisances. Whilst the average villager keeps the immediate surroundings of his hut in the most conceivable insanitary conditions, the interior of his dwelling is in marked contrast fairly clean. Water-supply, habitations, personal habits, and the prevalence of scabies are briefly touched upon. As some observers have been inclined to assign an important role to mosquitoes in the diffusion of leprosy, special attention was directed to the point, and with this view flies and mosquitoes were examined when full of blood sucked from the leper hosts, with negative results. If leprosy were so transmissible through the agency of insects, it would be much more common.

Diet.

From the earliest times various food-theories have been extant to account for the spread of leprosy. The only way in which any article of food can possibly have an ætiological connection with the disease would be by so modifying the tissues of the body through some chemical changes so as to make them more prone to disease. When the question of food is thus considered, there are two ways in which it may cause the disease. *Firstly*, by a direct introduction of the bacillus into the alimentary tract; *secondly*, by causing changes into the tissues capable of rousing into activity a bacillus already existing in them, or, as said above, of offering a suitable soil to a bacillus subsequently introduced into them.

Three substances up to the present have been singled out as having a casual relation to leprosy, *viz.*, fish, salt and water. A few remarks are here offered about the diets of the Indian community as a whole, which is almost entirely vegetarian, except the Mahomedan community and the lower castes. Rice, barley, gram, millets, jowari, bajri, ragi, wheat and the various pulses in various combinations, as available, form the staple articles of food with vegetables and fruit as obtainable.

Of all articles of diet none has been held more responsible for the causation of leprosy than fish. Fish alone, as advocated by Mr. Jonathan Hutchinson, or a combination of milk and fish have been held responsible. Mr. Hutchinson says that fish may cause the disease in one of several ways.

First, it may be by the direct introduction of the bacillus into the stomach; *secondly*, it may be that some element in fish-food rouses into activity a bacillus already existing in the tissues. But the Commissioners find that the bacillus is not capable of growing in a cold-blooded animal like the fish, and the result of their examination of a large number of fish, fresh and dried or prepared as "nga-pi" in Burma, has been entirely negative. Dr. Arning, who has studied the question most carefully, has also never been able to find any bacilli in fish. The next point to be considered whether it is possible for all lepers to have at one time or another consumed fish. The majority of Brahmins, Baniyas and Jains never touch flesh or fish, and yet leprosy occurs amongst them. Yet it is possible that there are certain castes who are forbidden fish and still take it, and, if asked about it, are likely to deny their having ever consumed it. Yet, if a large number of lepers are found who state that they have never eaten fish, and if they belong to the castes in which it is prohibited, it seems improbable that all of them should deceive the questioner or themselves. The Commissioners find that 162 individuals (lepers) denied ever having touched fish, although many of them were allowed to partake of animal food. Out of 464 lepers from various asylums, 99, or 21·3 per cent., denied ever having partaken of fish. In the Himalayan hill tracts fish is extremely

scarce, and out of 200 cases examined, it was found that 46, or 23 per cent., had never tasted fish, while a very large number used it now and then. The Commissioners, therefore, conclude that *there is thus, in the opinion of the Commission, no doubt that the consumption of fish is not the cause of leprosy.* The fact that a fair number of cases of leprosy exists amongst people who have never touched such food argues sufficiently strongly against the exclusive fish-hypothesis as above stated.

Salt is another article of food, a deficiency of which is supposed to have a casual relation with the disease. The Commissioners find that during the year 1890 the total quantity of salt that passed into consumption averaged about 11 lbs. per head per annum. The question then arises whether the price of this article prevents the native from procuring the amount of salt required to keep his body in proper health. It has been found that the highest cost per head is about one anna monthly. The average would be about 9 annas a year, and hence it cannot be said that the high price of this article debars the native from obtaining the necessary supply of salt. Two tables are appended in the report which show respectively the districts in which the price of salt has decreased and increased respectively during the last twenty years, and the figures there do not establish any casual connection between a high price of salt and leprosy. *The want of salt, therefore, cannot, in the opinion of the Commissioners, be held responsible for the origin and maintenance of the disease.* Two maps are inserted in the report to show the districts where the price of salt has risen and fallen and the increase and decrease in the leper ratios since the first census respectively, and these do not lend any support that the dearness of salt can be the cause of leprosy.

Lastly, water has been considered to be the vehicle of the leprosy bacillus, and thus a means of infection. The theory seems, however, highly improbable, for if water were the channel of infection, leprosy would be much more prevalent, and any one who has witnessed the life around the tanks in India, will easily conceive that a disease, if spread by means

of water, should be diffused to an alarming extent and at a great rate, especially if such disease be endemic and always present. It seems, moreover, very improbable that the leprosy bacillus is capable of multiplying outside the human body. It might remain dormant, but it has never been found in water, and the observations of the Commissioners are absolutely negative in this respect. They examined water from the tank at Tarn Taran, which is supposed to be beneficial to lepers, and is, therefore, always thronged by them. A large number of microscopical specimens were prepared from the water, but in not a single instance could leprosy bacillus be detected. *Water, therefore, can hardly be held responsible for the propagation of leprosy.*

Leprosy must be considered exclusively a *human disease*. For it does not attack domestic or other animals, and in no instance it has been found that the disease has been transmitted from an animal to man. The effects of social habits and customs, premature marriages and the consumption of opium, alcohol and other stimulants were also inquired into, but with entirely negative results.

Leprosy and Antecedent Diseases.

Syphilis is the disease with which leprosy has been confounded, and it was once thought to be a new form of leprosy. At the present time, however, the converse theory has been propounded, namely, that leprosy is nothing else but a modified form of syphilis. Syphilis and leprosy are no doubt more closely pathologically related than any other affection, but this can be no justification for the more modern theory. There is a greater resemblance, however, so far as local changes are concerned between lupus and leprosy, yet no one has ever ventured to identify these two affections with one another.

Sir William J. Moore is the exponent of the syphilis hypothesis, and considers leprosy a phase of inherited syphilis. In the opinion of the Commissioners this view cannot be supported, for the following reasons : (a) the history of this hypothesis is entirely against it ; (b) there is, at most, only a

resemblance or analogy traceable between the two diseases ; (c) certain clinical facts absolutely disprove the theory, unless the present views on syphilis be entirely modified or in part given up. The fact that people contract syphilis after having become affected with leprosy, is quite irreconcilable with the theory under consideration that leprosy is a phase of syphilis ; and it matters little whether it be congenital or acquired. Of 154 individuals who confessed to having suffered from syphilis, 12 had been thus affected after the appearance of leprosy. Out of 458 lepers examined, 88, or 19·2 per cent., were found at one time or another to have suffered from this disease. Although the proportion is rather high, it is quite possible that there is an element of error on account of the ignorance of the informants, yet many of these had unequivocal marks of tertiary syphilis on their bodies. It is possible that this may be disputed. However, three authentic cases were seen by the Commissioners where there could not be the slightest doubt that syphilis was contracted subsequent to the disease. These were all seen at the asylum at Madras. Two were young men who had suffered from leprosy for the last four and five years respectively ; each of them had a typical roseolar, secondary eruption, the characteristic appearances of the tongue, tonsils and fauces, and, moreover, one of them presented the remains of a true Hunterian sore, while the other had lost the frenum praepucii, and showed an unmistakable scar. The third case concerned a low-caste Hindu, 20 years of age, who had suffered from tubercular leprosy for the last twelve months, and at the time of examination actually had a primary sore on the glans penis. These three instances alone are sufficient to destroy the syphilis-hypothesis. It is quite possible that a certain number of the 154 individuals mentioned above as having suffered from syphilis, some were instances of gonorrhœa. But the fact that the remainder contracted syphilis at all, and that many of them had undoubtedly done so militates against Sir William Moore's theory. For, as these men became lepers they must have been born in the particular phase of congenital syphilis. How, then, is it to be

explained that many of these men presented the typical signs of tertiary syphilis concurrently with those of leprosy? Lastly, it has never been shown that syphilis passes into leprosy or *vice versâ*. Nor does syphilis ever modify the progress of the local changes in leprosy; and the converse also holds good. In conclusion, all that has been said on heredity may be used as arguments against this hypothesis.

It is, therefore, impossible to regard syphilis as having any real or specific influence on the production of the disease, or as acting otherwise than by lowering the general tone of the system and thereby rendering it more liable to attack by, or hastening the progress of, leprosy. Malaria and scrofula have also been considered in relation to leprosy, but there is no evidence in their favour.

The Commissioners then summarise as follows:—The Commission have come to the conclusion, after full consideration of the circumstances of life of the average native of India, that neither the form of diet, nor the sanitary environment of the individual, has any specific action in the causation of leprosy. But, as will be seen from what has been written, sanitation in this country is far from satisfactory, and leaves very much to be desired in the way of improvement. And it is probable that bad hygienic surroundings, deficient or improper food, poverty, exposure and such diseases as syphilis, are all factors of great importance in reducing the vital powers of the organism and rendering it more susceptible to attack. All such indirect or non-specific causes are specially operative in the case of the offspring of lepers, who are commonly beggars, and living under the most unfavourable conditions for health. Nothing has struck the Commission more forcibly during this enquiry than the improvement in the general health of the sufferer, which follows residence in a well-conducted asylum, where cleanliness, regular diet and sanitary principles are insisted upon and maintained.

Treatment of Leprosy.

The results summarised in this section have been mostly drawn from the reports—Government and others and those of

officers in charge of leper asylums and civil surgeons in India. Leprosy being an incurable disease, the treatment is therefore mainly palliative, and may be divided under three heads—

1. HYGIENIC.
2. MEDICINAL.
3. SURGICAL.

Hygienic.

This can be best ensured in well-regulated voluntary asylums under careful supervision, where the leper could be placed under good hygienic surroundings with regular and nourishing food, healthy out-door occupation and personal cleanliness: in fact, all such measures as would tend to his physical and moral well-being. The Commissioners noted a striking difference between the condition of lepers in well-organized asylums and that of homeless and friendless outcasts.

Medicinal.

In India the chief drugs used in the treatment of leprosy have been various vegetable oils. The following are those so used, according to Dr. George Watt, in the Dictionary of the Economic Products of India:—1, *Albizzia Lebbek*; 2, *Anacardium occidentale*; 3, *Cynometra ramiflora*; 4, *Dipterocarpus turbinatus*; 5, *Gynocardia odorata*; 6, *Hydnocarpus Wightiana*; 7, *Hydnocarpus venenata*; 8, *Pongamia glabra*; 9, *Psoralea corylifolia*; 10, *Semecarpus Anacardium*; and lastly, according to Dr. Vandyke Carter, the oil of *Arachis hypogæa*, the ground-nut. Of the above 11 oils, only 4 are considered as of importance. They are *Anacardium occidentale* or Cashew-nut oil, *Dipterocarpus turbinatus* or Gurjun or Kanyin oil, *Gynocardia odorata* or Chaulmoogra oil, and *Hydnocarpus Wightiana* or Kowti oil.

Anacardium Occidentale.

This oil was used by Dr. Beauperthuy at Cumana in Venezuela. The main features of the treatment were pure air, nourishing food, including fresh meat and vegetables and

abstinence from salted meat or fish. External applications of cashew-nut oil were preceded by frictions with cocoanut or olive oil and soap and water baths. Internally, perchloride of mercury $\frac{1}{15}$ to $\frac{1}{20}$ of a grain twice a day, and where mercury may be contraindicated sodium carbonate in 10—20 grain doses. This treatment afforded great relief, but the mistake made was in regarding it as curative. The results of the treatment were due to the strict regimen and attention to the functions of the skin. The oil of cashew itself is a mere caustic, and the results achieved by it could be more simply arrived at by free excision of tubercles. The internal medicines given could hardly have had any effect. With regard to internal medication in leprosy, there is always difficulty. The skin complications are amenable, but the Commissioners state that no drug has been discovered which, taken by the mouth, would bear the same relation to leprosy which mercury and potassium iodide bear to syphilis. Improvement is always followed by a relapse, which leaves the patient as bad or even worse than he was before treatment.

Dipterocarpus turbinatus.

Surgn.-Major J. Dougall of Port Blair, Andamans, advocated this oil, of which two emulsions were made, one, for internal administration, consisting of three parts of lime-water and one part of gurjun oil; the other, for external use, containing equal parts of gurjun oil and lime-water. The patients rose every morning at day-break and bathed, using dry earth as a detergent, so as to rub off the previous day's inunction. They afterwards drank half an ounce of the first emulsion, the second being then rubbed in for two hours. At 3 P. M. the same dose was given and another two hours' friction practised.

This treatment was adopted in 25 cases for a period of six months with very satisfactory results. On the whole, the experience all over India seems to be decidedly in favour of its producing only temporary relief, without any curative action, and not more than what could be obtained with any common oil. Dr. Dougall's success at Port Blair was probably due to the fact that he was dealing with a colony of convict lepers

under prison discipline, and was therefore able to carry out his plan of treatment far more rigorously than in an asylum where, as a rule, patients are averse to any therapeutic measures which involve the least exertion. It is quite possible that the prolonged frictions with dry earth and the regular sea-bathing were quite as potent in affording the relief as the use of the gurjun oil.

Gynocardia Odorata.

This oil is used both internally and externally. According to Dr. Vandyke Carter, chaulmoogra oil gives favourable results in early cases if used sufficiently long. It is in no sense a curative remedy, for the disease is never eradicated.

Mr. Sakharam Arjun, who was in charge of the ward for incurables in the Jamsetjee Jeejeebhoy Hospital, Bombay, gives his opinion in a report on leprosy, dated 1873, of the value of this oil as follows :—

“Under the prolonged and continuous use of this oil the progress of the disease is arrested, the skin becomes soft and supple, the discolorations vanish, the different morbid sensations leave the patient, the mental hebetude passes away, the impaired sensibility is completely or partially restored, the ulcers heal and cicatrize though ever prone to break out again, and the general nutrition of the tissues improves, patients crippled before being known to walk about unassisted and to gain in strength and weight.”

In the Trinidad Leper Asylum one man used the oil internally and externally for seven years. The tubercles disappeared from his face and extremities, and the anæsthesia was lessened. The chief results obtained in 18 cases were :—
1. Increase of perspiration. 2. Decrease of tubercles. 3. Improved appetite and sense of well-being. 4. Increase of sensation. 5. Increased suppleness of skin and lessening of pain in joints.

On the whole, therefore, the action of chaulmoogra oil in leprosy, though at the best palliative, is more decided than

that of gurjun oil, and, as said above, its prolonged use may arrest at times the progress of the disease, though for how long must still be doubtful.

Hydnocarpus Wightiana.

To Mr. Bhao Daji of Bombay belongs the credit of introducing this oil to the notice of the profession, and he used it in combination with chaulmoogra oil in the treatment of leprosy. The results of treatment were merely palliative, as the symptoms were simply quiescent, according to Dr. Carter, who, however, considers that kowti oil is a useful aid in the treatment of leprosy. The rest of the oils are not considered specific in any sense, and hence the Commissioners did not think it necessary to discuss them. Two other Indian plants have been vaunted as specifics for leprosy, but they seem to have no such effect. They are the Madar (*Calotropis gigantea*) and the Asiatic pennywort (*Hydrocotyle Asiatica*).

Arsenic is a drug which has been extensively used, and in some cases with marked effect, and is a valuable palliative and an adjunct to other treatment.

The treatment by ichthyol and resorcin introduced by Dr. Unna of Hamburg has invariably proved a failure. The effects resulting from the vigorous treatment advocated by the author are as well achieved by more simple measures.

Dr. Lutz of Hawaii has lately recommended salol and salicylate of soda internally and chrysarobin and pyrogallie acid externally. Surgn.-Major H. D. Cook treated a number of patients with salol in the Madras Leper Asylum, and he confirms the opinion of Dr. Lutz that, as a palliative, salol is of decided value in leprosy. But after a prolonged trial extending over some months, Dr. Cook has come to the conclusion that salol is of no therapeutic value in leprosy, and that, in fact, it is a decided failure. It was administered in 20-grain doses 3 times a day, which was afterwards increased to 30 grains. The results at first were decidedly encouraging, viz., the ulcers healed, the tubercles decreased in size, ulcerated and then subsided or healed up, the sensation was

often restored, the patches improved in color and the skin assumed a more healthy appearance. But after 3 months' continuous treatment of 12 cases, some only derived benefit while the others improved in parts previously affected, but have broken out in parts formerly unaffected. Fresh tubercles and fresh ulcers appeared after those in existence before treatment had healed up. In conclusion, Dr. Cook states that, considering that leprosy is a disease requiring a steady persevering course of treatment extending over a period of three months, if necessary a year, a specific that would recommend itself and combat successfully with the disease must necessarily possess properties of a progressively beneficial nature, so that its continued use would have no disagreeable counteraction ; it must have tonic and alterative properties and be such that its use could be continued for a long time without the least ill effect. Salol in his estimation does not fulfil these conditions, and he, therefore, regards the drug as a decided failure.

The ordinary tonics and alteratives, *viz.*, perchloride of iron, potassium iodide, mercury and cod-liver oil are useful adjuncts in the treatment of leprosy. Some observers have overrated the risk of giving mercury to leprosy patients, but the Commissioners state that the drug may be administered with ordinary care as freely as in any other disease.

From the above evidence it is clear that chaulmoogra oil and arsenic are the most valuable drugs at present known for the palliative treatment of leprosy.

In an appendix to the section on treatment the Commissioners give the results of experiments conducted by Dr. Cook of Madras with Koch's Tuberculin, and state that they have no doubt that, as far as leprosy is concerned, the remedy is of no therapeutic value ; but, on the other hand, may not be altogether free from danger. The immediate effect of injecting tuberculin was a rise in temperature attaining temporarily a maximum of 105° in 3 out of the 12 cases experimented upon ; in others it averaged only 100.5° .

Surgical.

Any operation which would be undertaken on an ordinary patient may be performed on one suffering from leprosy. The tissues of lepers heal with marked rapidity after operation, and this is supposed to be due to the excess of fibrin found in the blood of these patients.

Nerve-stretching has yielded good results as a means of treatment in leprosy, and has been practised by Drs. Lawrie, Downes, Neve, Mitra and others. In Trinidad, out of 100 cases operated on, more or less relief was obtained in about half. The chief results noted were : relief of pain in the course of the nerves operated on, healing of perforating ulcers in the area supplied by these nerves, and more rarely some decrease of anæsthesia. Unfortunately, none of these effects were permanent, and the operation had sometimes to be repeated on the same nerve. There is no doubt, however, that nerve-stretching is a valuable aid especially in the treatment of the distressing neuralgia which often complicates leprosy, but the operation cannot be claimed in any way curative.

Free excision of cutaneous tubercles is a procedure which is followed for a time by good results, but they recur in the sound skin round the cicatrices of former tubercles.

Free incision down to the bone in perforating ulcers and in sinuses accompanied by pain gives great relief. Early incision in such cases often prevents gangrene, and when this has actually set in, amputation high up will often save life.

Tracheotomy is at times required by the invasion of tubercles in the larynx.

Ophthalmic complications are very common in leprosy, the two commonest being tubercles of the cornea and paralytic ectropion. The former have been arrested with considerable success by Kaurin by the performance of keratotomy. Cauterizing the conjunctiva or cornea round the tubercle have produced similar results under Danielssen and Hansen. In the Trinidad Leper Asylum ligature of the vessels supplying the tubercle has arrested its growth for a time. Irredec-

tomy in some cases temporarily averts total blindness, though it is powerless to check the further progress of the disease. For paralytic ectropion Kaurin practises tarsoraphy with good results. Epiphora is greatly reduced, and closure of lids is effected. This section concludes with a table giving the results of medical and surgical treatment adopted in various Indian stations.

CONCLUSIONS.

The following conclusions are based upon the observations and arguments contained in the foregoing report :—

1. Leprosy is a disease *sui generis*; it is not a form of syphilis or tuberculosis, but has striking ætiological analogies with the latter.
2. Leprosy is not diffused by hereditary transmission, and for this reason, and the established amount of sterility among lepers, the disease has a natural tendency to die out.
3. Though in a scientific classification of diseases leprosy must be regarded as contagious and also inoculable, yet the extent to which it is propagated by these means is exceedingly small.
4. Leprosy is not directly originated by the use of any particular article of food, nor by any climatic or telluric conditions, nor by insanitary surroundings; neither does it peculiarly affect any race or caste.
5. Leprosy is indirectly influenced by insanitary surroundings such as poverty, bad food, or deficient drainage or ventilation; for these, by causing a predisposition, increase the susceptibility of the individual to the disease.
6. Leprosy in the great majority of cases originates *de novo*, that is, from a sequence or concurrence of causes and conditions dealt with in the report, and which are related to each other in ways at present imperfectly known.

PRACTICAL SUGGESTIONS.

Segregation may be voluntary or compulsory, and in either instance partial or complete. Complete segregation has never

yet been possible. Both in Sandwich Islands and in Norway it has failed. For India, complete compulsory segregation may be considered absolutely impracticable. Neither do the conclusions given above as to the nature of the disease justify any recommendation for absolute segregation. The presence of a leper in a healthy community is a source of danger no greater than the presence of an individual suffering from tuberculosis. Both diseases are contagious in an equal and minimal degree. The amount of ulceration which exists in both diseases is to some extent a measure of the danger of contagion.

It is impossible, for the same reasons, to advise compulsory partial isolation. Voluntary isolation is therefore recommended by the Commissioners as extensively as local circumstances would allow, and which would be greatly facilitated by permitting marriages among lepers.

The Commission are of opinion that the sale of articles of food and drink by lepers should be prohibited, and that they should be prevented from practising prostitution and from following such occupations as those of barber and washerman, which concern the food, drink, and clothing of the people generally, quite apart from the dread of a possible infection.

Vagrant and indigent lepers living in the villages and scattered about the country are probably sources of little or no danger. No harm is likely to result from their soliciting alms by the roadside. But the present tendency of vagrant lepers to crowd into large centres of population, and to live there under circumstances of extreme poverty and filth and forming communities which are not only offensive to public decency, but constitute from many points of view a menace to the public health, should be discouraged. They form in such colonies promiscuous and casual alliances resulting in the birth of children doomed to struggle for existence under circumstances most painful to contemplate. The Commission consider that the best policy in dealing with this matter is to discourage this concentration of lepers in towns and cities,

and, to this end, would suggest that Municipal authorities be empowered to by-laws preventing vagrants suffering from loathsome diseases from begging in, or frequenting, places of public resort or using public conveyances.

The existing asylums near large presidency towns might be enlarged by municipal funds or private subscriptions. Where they do not exist, they should be built near towns, and the authorities should have the power of ordering lepers infringing the regulation either to return to their homes or to enter an asylum.

Competent medical authority should always be consulted before action is taken under such by-law.

In no case would the Commissioners suggest an Imperial Act especially directed against lepers as such, for these are far less dangerous to a community than insane or syphilitic people.

The effect of such by-laws in large towns would be an emigration into the surrounding country, and a furtherance of the scheme now to be proposed for establishing experimental leper colonies or farms in rural districts. Land might be granted, cheap buildings raised, seeds distributed and work supplied. The produce might partially support the colony, and a small fixed money allowance might be given or a small bounty be paid on the produce raised by each leper.

The few children that might be born should be, if possible, removed to orphanages, a certain number of which would be required: the inmates might be discharged as soon as they were old enough to support themselves.

In conclusion, the Commissioners believe, from the considerations and arguments adduced in the foregoing report, that neither compulsory nor voluntary segregation would at present effectually stamp out the disease or even markedly diminish the leper population under the existing conditions of life in India. It can only be hoped that by means of improved sanitation and good dietetic conditions a diminution of leprosy will result. The Commission agree with most

authorities in believing that the decline of leprosy in Europe has been due principally to improved hygienic habits and surroundings and increased material prosperity.

The report is signed by all the English and Indian members of the Commission, and the name of the late Surgeon-Major A. Barclay is appended to it as the conclusions and suggestions were drawn up previous to his death and were known to be in accordance with his views.

The report is followed by two appendices—the first one containing an account of laboratory work done in Almora and Simla by Drs. Rake, Buckmaster and Thomson, and the second containing work done independently at Simla by Drs. Kanthack and the late Surgeon-Major Barclay.

We append a brief summary of the same from the *Lancet* of May 13th, 1893 :—

The bacteriological work carried out by the Commissioners of the Indian Leprosy Fund has not materially added to our knowledge of the bacillus lepræ, which was first identified by Armaner Hanser in leprous tubercles 25 years ago. At the same time, the record of the work of the Commissioners is highly instructive in its negative as well as in its positive results. It had further the advantage of being done, as it were, in duplicate—Drs. Rake and Buckmaster and Surg.-Major Thomson working in the laboratories at Almora and Simla and the late Surgeon-Major Barclay and Mr. A. A. Kanthack at Simla. Thus two concurrent and independent series of observations were being carried on under similar conditions. Harmony in their results was to be expected, but it is not the less valuable as evidence of the trustworthiness of this line of research. At the same time it did not always obtain. The confirmation given to the invariably characteristic relationship of the bacillus to leprosy gives one more proof that it is as much a concomitant of that affection as Koch's bacillus is of tuberculosis. It is singular how slight are the differences obtainable between these two micro-organisms, being not so much morphological as concerned

with their relative behaviour to staining reagents. It is pointed out, however, that these micro-chemical tests are hardly absolute enough to differentiate these organisms, which can be, perhaps, more safely distinguished by the degree and manner of their aggregation within cells.

Examination of Blood and Excretions.

The first-named of the two groups of investigators relates that observations were made upon certain fluids and secretions. Specimens of the blood from six lepers were examined without result, even where the blood came from a leprous tubercle. Bacilli were found in the serum obtained by blistering over the tubercles, but not from blisters raised over anæsthetic patches or normal skin. The juice from leprous tubercles examined never failed to yield quantities of bacilli, except under conditions involving error in preparation or observation, or when the tubercles were old and degenerate. Similarly the discharge from tuberculated ulcers yielded them, but not that from anæsthetic ulcers. Bacilli were found in the water in which a leper had washed his tuberculated and ulcerated feet, but no colonies could be obtained in plate cultivations of this water—a result explicable in the view that the bacilli were no longer living, or else that they were overpowered in the struggle for existence with other organisms which abounded in the discharge. The organisms were found in specimens of saliva in cases where the tongue was ulcerated and in one of two specimens of vaginal mucus from leprous girls. As regards the excretions, the bacilli were never found in the urine, in the fæces in only one specimen (from a case in which they had also been detected in the saliva), and in the sputum in 4 out of 6 patients affected with leprosy of the larynx. In neither of the 2 specimens of menstrual discharge examined were the bacilli present. Contrasting these results with those of a similar investigation by Surgeon-Major Barelay and Mr. Kanthack, we find that the latter obtained positive results in only 1 out of 20 specimens of discharge from the sores of 2 ‘mixed lepers;’ that 12 specimens of blood and lymph from a tubercle (2 cases)

yielded bacilli in all cases, and that bacilli were found in 2 specimens (out of 20) of blood and lymph from healthy but anæsthetic skin from a mixed leper; no bacilli were found in 60 specimens of blood from 6 anæsthetic lepers, nor in 40 specimens of blister fluid over tubercles in 4 cases. The saliva of 3 tuberculous lepers invariably yielded the bacilli (30 specimens examined), and the nasal secretions frequently (14 positive to 6 negative results); whilst a negative result was obtained in 50 specimens of vaginal discharge from a tuberculous leper and in 50 specimens of menstrual discharge from an anæsthetic leper.

Distribution of Leprosy Bacilli outside the Body.

Observations were made upon specimens of earth taken within the Almora Asylum and only 10 bacilli were found in 100 specimens, and 300 specimens of dust collected from huts inhabited by tuberculous lepers with ulcerated feet were wholly negative. Neither set of observers found bacilli in the water of tanks at Bombay, Almora and Tam Taran frequented by the lepers for bathing. Specimens of dried fish—a staple diet at Darjeeling—and crustacea collected from various parts contained numerous bacteria, but no distinctive leprosy bacilli. Lastly, the possibility of the communicability of leprosy through the medium of flies was tested by the examination of the bodies of flies which had settled on ulcerated sores of lepers; but no bacilli were found within them. A similar negative result followed the examination of mosquitos by Mr. Kanthack and Surgeon-Major Thomson.

Vaccination.

An extended series of observations was made in view of the allegation that leprosy can be transmitted by vaccination. The contents of vesicles from forty lepers in Almora who had been vaccinated were examined for bacilli, and in no case (93 specimens examined) were they found, although in one case in 'vesicles raised over tuberculated ears' and, in another, in 'vesicles over anæsthetic patches,' 'suspicious-looking rods taking fuchsin' were discovered. 'But even if

these cases be considered as positive, and the utmost value allowed to them, they would have little or no importance on the question at issue, for no vaccinator would be likely to vaccinate a leper over a tubercle or anæsthetic patch and use the lymph obtained from such vesicles for vaccinating healthy individuals.

Cultivation Experiments.

The account of the attempts at cultivation of the leprosy bacillus is preceded by a historical sketch which shows clearly the discrepant results hitherto obtained. The experiments by Dr. Rake, Dr. Buckmaster and Surgeon-Major Thomson were made with fluid from blisters over tubercles, with excised tubercles, and with the expressed juice from tubercles. As regards the first-named source, a successful culture was obtained first in bouillon and from this by inoculation in gelatine and glycerine-agar, the growth being carried on to the sixth generation. In one of the tubes in which portions of sterilised leprosy tissue were placed a culture of a vacuolated bacillus was obtained much resembling that obtained from the blister fluid, whilst in another experiment a culture of bacilli occurred in two tubes of bouillon exactly resembling that of the first experiments. Particular stress is laid upon the aggregation of these bacilli in groups. A like successful culture in bouillon was made from the juice of a leprosy tubercle. It is, however, pointed out that the identity of these cultivated organisms with the leprosy bacillus is not beyond question, for, although the same organism was obtained from three diverse sources, it had not the same morphological characters, although responding to the same staining reactions, as the bacillus lepræ. The pathogenic character of the cultivated bacillus has not been proved. Mr. Kanthack also made cultivation experiments (in conjunction with Surgeon-Major Barclay), but "after a careful review of all the facts, benefiting by the lucid criticism of Professors C. Fraenkel and Baumgarten," he feels "convinced that the artificially-grown bacillus was not the leprosy bacillus."

Inoculation Experiments.

It is needless to enter into the details given in the appendix to the report of the experiments conducted with a view to ascertain whether leprosy could be transmitted to other animals by experimental inoculation. They were all negative in their result, although conducted with every care and precaution. The general inference is that the bacillus lepræ is either a distinctly human parasite and is incapable of propagation in other animals, or that means have yet to be devised to effect its cultivation in media outside the human body and its transmission in the form of a pure culture to susceptible animals.



The following is the Memorandum on the Report of the Indian Leprosy Commission by the Executive Committee of the National Leprosy Fund :—

The following are the main points of the Memorandum on the report of the Leprosy Commissioners, as prepared by a Special Committee appointed for the purpose, and endorsed or annotated by members of the Executive Committee :—

The Committee, having been instructed to consider and report upon the publication of the report of the Leprosy Commissioners in India in 1890-91, beg to submit the following considerations: The Committee desire to place on record their sense of the ability with which the Commissioners conducted their investigations whilst in India and of the comprehensive and valuable nature of their report. After specifying the conclusions of the Commissioners (which we give in the above abstract of the report), the Committee, in reference to the suggested regulation of lepers and leprosy by means of by-laws framed by the various municipalities, writes as follows :—

(a) The Commission are of opinion that the sale of articles of food and drink by lepers should be prohibited and that they should be prevented from practising prostitution and from following such occupations as to those of barber and washer-

man, which concern the food, drink and clothing of the people generally, quite apart from the dread of a possible infection.

(b) The Commission consider that the best policy in dealing with the concentration of lepers in towns and cities is to discourage it, and to this end would suggest that municipal authorities be empowered to pass by-laws preventing vagrants suffering from leprosy from begging in or frequenting places of public resort, or using public conveyances.

(c) The large Presidency towns and the capitals of provinces in many cases already possess leper asylums, which might be enlarged by municipal funds or private subscriptions. Asylums should be built near towns where they do not already exist, and the authorities should have the power of ordering lepers infringing the regulations either to return to their homes or to enter an asylum.

(d) Competent medical authority should always be consulted before action is taken under such by-laws.

The Committee accept Nos. 1, 2, 4 and 5 of the conclusions of the Commission ; but not being satisfied with the evidence offered by the Commissioners they express their disagreement with the concluding words of No. 3, *viz.* :

“That the extent to which leprosy is propagated by contagion and inoculation is exceedingly small.”

They cannot concur in the views expressed in No. 6—namely, that

Leprosy in the majority of cases originates *de novo*—that is, from a sequence or concurrence of causes and conditions, dealt with in the report, and which are related to each other in ways at present imperfectly known,—

being of opinion that the evidence adduced in the report does not justify such conclusions.

The Commissioners have expressed opinions strongly adverse to compulsory segregation, either complete or partial. They say :—

No legislation is called for on the lines either of segregation or of interdiction of marriages with lepers.

For India complete compulsory segregation may be considered to be absolutely impracticable. Neither do the conclusions given before as to the nature of the disease justify any recommendation for absolute segregation.

It is impossible for the same reasons to advise compulsory partial isolation. Voluntary isolation is therefore the only measure left for consideration.

In no case would the Commissioners suggest an Imperial Act especially directed against lepers as such.

In conclusion, the Commissioners believe, from the considerations and arguments adduced in the foregoing report, that neither compulsory nor voluntary segregation would at present effectually stamp out the disease, or even markedly diminish the leper population, under the existing conditions of life in India.

The Committee, having expressed their inability to accept the reasoning upon which the Commissioners have based the above conclusions, state that they are equally unable to accept the corollary that segregation in any case of leprosy in India is either impracticable or undesirable. They entertain a precisely opposite opinion, and would be sorry if the Government of India were encouraged by the report of the Commissioners to refrain from taking the necessary steps in the direction of such segregation of lepers as may be found possible. Their opinions upon segregation are in accord with those expressed in the following extract from a memorandum by Dr. Vandyke Carter :—

Modes of Segregation.

I. "By erecting plain asylums at certain centres, each of which would be a refuge common to several districts and a place of detention under due management and supervision."

II. "By founding leper colonies or village communities mainly of the affected, who, whilst allowed more liberty of movement, should yet be prevented from mingling with the peasantry around ; hence still the need of strict supervision.

Many spots would thus serve—such as deserted forts, decayed villages and places now waste, yet not far from other sources of supply, or not without near resources easily resuscitated.”

III. “By requiring the strict isolation of leprosy subjects retained in their homes at express wish of friends. Suitable separate lodgment would be indispensable ; unsuitable shelter is even now sometimes supplied. Joining of such home isolation with more public measures should not be overlooked, for to it experience in Norway seems to point as a means essential to complete success within a moderate period of time ; and in India it would have to be still more largely resorted to.

IV. “For carrying out the above, in addition to funds, legislative authority is needed to take up the vagrant sick, to remove the sorely diseased who is insufficiently guarded at home, and at times to enforce continued isolation of the infected until medical sanction of liberty be granted.”

The Committee give a general approval to the minor recommendations of the Commissioners, numbered above as (a) (b) (c) (d), for the regulation of lepers and leprosy in India, which they consider might with advantage be carried out, though they do not concur in the opinion that municipalities would be necessarily or universally the best means of effecting that object.

The Memorandum is signed by—

Nominated by the Executive Committee of the National Leprosy Fund.	{	GEORGE N. CURZON (Under Secretary for India), Chairman. EDWARD CLIFFORD.
Nominated by the Royal College of Physicians.	{	*DYCE DUCKWORTH, M.D., LL.D. G. A. HERON, M.D., F.R.C.P.
Nominated by the Royal College of Surgeons.	{	*JONATHAN HUTCHINSON, LL.D., F.R.S. N. C. MACNAMARA, F.R.C.S.

[The above were the members of the Special Committee.]

Chairman of the Executive Committee.	} FERDINAND ROTHSCILD.
	{ F. LONDIN.
	{ *ANDREW CLARK, M.D., F.R.C.P.
	{ *JAMES PAGET.
Members of the Executive Committee.	{ *J. FAYRER.
	{ *W. GUYER HUNTER.
	{ *JONATHAN HUTCHINSON.
	{ E. CLIFFORD.
	{ ALGERNON BORTHWICK and EDWARD LAWSON, Honora- ry Treasurers.

Independent or Dissident Opinions.

The following independent or dissident opinions have been expressed by members of the Special Committee and of the Executive Committee;—

“‘*Leprosy is not diffused by hereditary transmission.*’ I do not think that this is proven.”—J. FAYRER.

“‘*Contagious and also inoculable.*’ This is also uncertain.”—J. FAYRER.

“I understand the Commissioners to mean by the expression *de novo* in reference to the origin of leprosy that they believe that the disease may begin independently of personal contagion and in connexion with climatic and dietetic causes. In that belief I entirely share. I also agree in the main with the rest of the statements in the Commissioners’ report, to which exception has been taken in our committee. I feel convinced that if leprosy be contagious at all it depends but to an almost infinitesimal extent upon contagion for its spread.”—JONATHAN HUTCHINSON, LL.D., F.R.S.

“I am in agreement generally with the recommendations of the Commission respecting *voluntary isolation* and the issue of *Municipal By-laws* regulating the habits of lepers. I

know no trustworthy evidence to prove that a leper in any community is a source of greater danger than is a consumptive patient, and I know that a person suffering from syphilis is a real and very positive source of danger anywhere. It would therefore be absurd on the face of it to adopt stringent laws for the leper and to let the syphilitic person go free.

“The intelligent layman now imagines that, because bacilli are an essential feature of leprosy, therefore the disease *must* be readily contagious. This is simply quite contrary to fact. The same thing holds good exactly for consumption and for some other disorders in which microbes play a part.

“I think a well-empowered and vigorously supported Government medical executive officer should be appointed in every large town and in certain districts to supervise the leprous populations and report regularly upon them. It should be his business to see that the local regulations are fully carried out, and on his requisition only should any action be taken when necessary.

“Suitable asylums should be provided and those now existing should be sufficiently enlarged to meet the needs that will arise under suitable by-laws.

“The project of leper-farms is, I think, a good one. More than this is, I believe, not within any practical scheme for amending the condition of lepers and for diminishing the spread of the malady.”—DYCE DUCKWORTH, M.D., LL.D.

“I am strongly in favour of the maintainance (by Government or otherwise) of voluntary homes for lepers, but do not believe that segregation would effect anything in diminishing the prevalence of the disease. Compulsory segregation would, I think, involve injustice and entail much social misery. I believe that our Commissioners' report well expresses not alone the opinions of those who have signed it, but, in a general way, those of the educated classes of the present day throughout India.”—JONATHAN HUTCHINSON, LL.D., F.R.S.

“I think the report a most valuable and excellent one, agreeing generally with the remarks of the Committee. I concur in the objections made by Sir Dyce Duckworth and Mr.

Hutchinson. I have also noted two remarks which I do not consider can be accepted as proven.

“ But on the whole I regard the report as most excellent, and, if the recommendations are acted on, one which will prove of the greatest benefit to the population of India. When leprosy disappears, it will do so as a result of improved hygienic and social conditions.

“ In the meantime all that is possible—as suggested in the report—to be done should be done to ameliorate the condition of the sufferers, and I am glad to find that coercive measures of segregation or wild fear of contagion are not contemplated.”—J. FAYRER.

Further Memorandum.

“ We, the undersigned members of the Executive Committee of the National Leprosy Fund, desire to express our approval of the Commissioners’ report, which we regard as a very careful record of well observed important facts. We concur with their suggestions of ‘ the practical measures to be taken for the control or the restriction of the disease in India.’ We dissent from the opinion expressed in the body of the report of the Special Committee on the subject of the contagion of leprosy and from the recommendations founded on that opinion. We believe that the evidence of the spread of leprosy by contagion is not sufficient to justify the compulsory segregation of lepers, though the institution of homes in which they may voluntarily reside may be very earnestly advised. And we are of opinion that, although an unusual susceptibility of leprosy may be transmitted by inheritance, and the children of lepers may be more than others liable to the disease if living in the conditions in which it generally occurs, this does not supply reason sufficient for prohibiting the marriage of the leprous.

“ ANDREW CLARK, M.D., F.R.C.P.
W. GUYER HUNTER.
JAMES PAGET.
J. FAYRER.
JONATHAN HUTCHINSON.”